

PERFORMANCE TEST 3.3

- (2) Second, push the knurled knob forward and rotate clockwise, locking the valve in the open position.
- c. Open transfer tank pressure build-up valve (GV-5)

WARNING: Observe transfer tank pressure gage, do not allow pressure build-up in excess of 90 p.s.i.g.

- d. Close transfer tank pressure build-up valve when pressure reading is 90 p.s.i.g.
- e. Operate transfer tank pressure build-up valve as necessary to maintain the desired pressure during converter servicing
- f. Open the converter vent line shut-off valve and observe the converter full indicator gage.
(1) Gage should read GAS when converter is filling
(2) When full, gage will indicate LIQUID
- g. When the converter is full, disconnect the AF filler valve
- h. Install dust cap to converter filler valve

4. Securing trailer

- a. Close the transfer tank pressure build-up valve.
- b. Close the converter vent line shut-off valve
- c. Disconnect converter vent line connector
- d. Empty the transfer tank.
(1) Open transfer tank fill line shut-off valve.
(2) Open transfer tank pressure build-up valve
(3) Observe transfer tank liquid level gage
(4) When the transfer tank is empty, close the transfer tank pressure build-up valve and the transfer tank fill line shut-off valve
- e. Close all valves except for storage tank vent line shut-off valve, for normal idle storage

5. Documentation

- a. Complete Support Action Form (SAF), using the following information:

To support the operation of an A-4A aircraft, type code (AACA), assigned to organizational squadron center 13B serviced the LOX system on today's date support of aircraft bureau number 152513.

- b. Support action form will be graded as follows:

Each block correctly documented will have a two

MAINTENANCE OF SHOP SUPPORT EQUIPMENT

TIME: 2 per

INTRODUCTION:

The purpose of this sheet is to guide you step-by-step in a practical work assignment in the maintenance of shop support equipment.

ENABLING OBJECTIVE

Supported partially by this lesson topic:

1.7 and 2.4.

REFERENCES:

1. Naval Aviation Maintenance Program (NAMP), Volume II, OPNA 4790.2 (Latest rev.).
2. Safety Precautions for Shore Activities, NAVMAT P-5100.

EQUIPMENT AND MATERIALS:

1. Tools
2. Cleaning gear

PRECAUTIONS TO BE OBSERVED:

Take all necessary steps to ensure your safety and that of the equipment.

JOB STEPS:

1. Classroom Support Equipment
 - a. Repair or replace any defective classroom support equipment.
 - b. Stow instructional training aids in areas designated by instructor.
2. Shop Support Equipment
 - a. Repair or replace any defective shop support equipment

- (2) Second, push the knurled knob forward and rotate clockwise, locking the valve in the open position.
- c. Open transfer tank pressure build-up valve (GV-5).

WARNING: Observe transfer tank pressure gage, do not allow pressure build-up in excess of 90 p.s.i.g.

- d. Close transfer tank pressure build-up valve when pressure reading is 90 p.s.i.g.
- e. Operate transfer tank pressure build-up valve as necessary to maintain the desired pressure during converter servicing
- f. Open the converter vent line shut-off valve and observe the converter full indicator gage.
 - (1) Gage should read GAS when converter is filling . . .
 - (2) When full, gage will indicate LIQUID
- g. When the converter is full, disconnect the AF filler valve
- h. Install dust cap to converter filler valve

Securing trailer

- a. Close the transfer tank pressure build-up valve.
- b. Close the converter vent line shut-off valve
- c. Disconnect converter vent line connector
- d. Empty the transfer tank.
 - (1) Open transfer tank fill line shut-off valve.
 - (2) Open transfer tank pressure build-up valve
 - (3) Observe transfer tank liquid level gage
 - (4) When the transfer tank is empty, close the transfer tank pressure build-up valve and the transfer tank fill line shut-off valve
- e. Close all valves except for storage tank vent line shut-off valve, for normal idle storage

Documentation

- a. Complete Support Action Form (SAF), using the following information:

To support the operation of an A-4A aircraft, type equipment code (AACA), assigned to organizational squadron GC7, work center 13B serviced the LOX system on today's date in general support of aircraft bureau number 152513.

- b. Support action form will be graded as follows:

Each block correctly documented will have a two point

ipment.

BLING OBJECTIVE

ported partially by this lesson topic:

and 2.4.

ERENCES:

Naval Aviation Maintenance Program (NAMP), Volume II, OPN 4790.2 (Latest rev.).

Safety Precautions for Shore Activities, NAVMAT P-5100.

IPMENT AND MATERIALS:

Tools

Cleaning gear

CAUTIONS TO BE OBSERVED:

e all necessary steps to ensure your safety and that of the
ipment.

STEPS:

Classroom Support Equipment

- a. Repair or replace any defective classroom support equipment.
- b. Stow instructional training aids in areas designated instructor.

Shop Support Equipment

- a. Repair or replace any defective shop support equipment.
- b. Service TMU/70M LOX Servicing trailer.
- c. Stow shop support equipment in areas designated by instructor.

FOREWORD

The purpose of this Student's Guide is to direct your progress through Unit 3 of the Aviation Structural Mechanic E (Safety Equipment) Course, Class A1. By following this guide, you will find notes that will be of assistance to you as you progress through this unit.

The table of contents lists the page numbers for the learning objectives, safety notice, and other instructions for using this guide. Notetaking and assignment sheets are listed according to lesson topics.

FOREWORD

The purpose of this Student's Guide is to direct your progress through Unit 3 of the Aviation Structural Mechanic E (Safety Equipment) Course, Class A1. By following this guide, you will make notes that will be of assistance to you as you progress through this unit.

The table of contents lists the page numbers for the learning objectives, safety notice, and other instructions for using this guide. Notetaking and assignment sheets are listed according to lesson topics.

SAFETY NOTICE

an AME, you will become qualified in the maintenance of life support systems on naval aircraft. The term "life support" demands that every maintenance person in the AME rating be extremely knowledgeable about all safety precautions and develop safety conscious habits when performing maintenance on one of these life support systems. Many times a pilot has only one chance for survival and that chance is directly related to how well you perform your job as an AME.

HOW TO USE THIS STUDENT'S GUIDE

This Student's Guide has been prepared for you to use while attending the Aviation Structural Mechanic E (Safety Equipment) course, Class A1. The notetaking sheets will provide you with ample space for taking notes on the required lesson information.

This volume contains the following types of instruction sheets:

- Assignment sheets for each lesson topic to direct your homestudy efforts.

- Notetaking sheets containing both lesson topic outlines and ample blank space for personal notetaking.

- Job sheets, as required, will guide you step-by-step in a practical work assignment.

MATCH, from given lists, the components of a gaseous oxygen system with their purposes, in accordance with NA 01-75DAA-2-2.3.

4 MATCH, from given lists, the components of an integrated bailout unit with their purposes, in accordance with NA 01-40AVA-2-4.

These objectives are entirely supported by this lesson topic:

- 1.1 SELECT, from a given list, the percentage of gases that make up the atmosphere.
- 1.2 SELECT, from a given list, the partial pressure of oxygen at sea level.
- 1.3 MATCH, from a given list, conditions caused by oxygen starvation and decreasing atmospheric pressure with their descriptions.
- 1.4 SELECT, from a given list, four characteristics of gaseous oxygen.
- 1.5 SELECT, from a given list, the four characteristics of liquid oxygen.
- 1.6 SELECT, from a given list, the two types of oxygen used in naval and Marine Corps aircraft.
- 1.7 MATCH, from a given list, the three grades of gaseous oxygen with their names and descriptions.
- 1.8 SELECT, from a given list, the three flight requirements for the use of oxygen in naval and Marine Corps aircraft.
- 1.9 SELECT, from a given list, four of the six basic safety precautions that must be observed when gaseous oxygen is used.
- 1.10 SELECT, from a given list, four of the five basic safety precautions to observe when handling and storing liquid oxygen.
- 1.11 SELECT, from a given list, four of the five characteristics of gaseous nitrogen.
- 1.12 MATCH, from a given list, the three types of nitrogen with their uses.
- 1.13 SELECT, from a given list, five of the six basic safety precautions to observe when handling and storing liquid oxygen.

LIARIZATION WITH AIRCRAFT LIQUID OXYGEN SYSTEMS

FINAL OBJECTIVE

s objective is partially supported by this lesson topic.)

PERFORM an operational check of an aircraft liquid oxygen system, under supervision, in accordance with NA 01-40AVA-2-4. Record the maintenance action on appropriate source document(s), in accordance with OPNAVINST 4790.2 (series). All entries must be legible and correct. Tool control procedures and safety precautions must be observed in accordance with OPNAVINST 4790.2 (series) and 5101.2 (series).

LEARNING OBJECTIVES:

se objectives are supported partially by this lesson topic.)

PERFORM a daily/preoperational inspection of a TMU-70/M liquid oxygen servicing trailer, under supervision, in accordance with NA 19-250-26.

SERVICE an aircraft liquid oxygen converter, under supervision, in accordance with NA 02-40-AVA-2-2 and NA 19-240-26. A maximum of two errors will be allowed.

upported entirely by this lesson topic.)

14 SELECT, from a given list, the advantage of a liquid oxygen system as compared to a gaseous system.

15 MATCH, from a given list, the three types of liquid oxygen systems with their pressure and flow rate.

16 MATCH from a given list, the components of a liquid oxygen system with their purpose and location.

17 Using a liquid Oxygen Flow Schematic, TRACE the normal operation of a liquid oxygen System.

18 SELECT, from a list, the safety precautions pertaining to liquid oxygen.

MATCH, from given lists, the names of the components of a aircraft liquid oxygen system with their purposes, in accordance with NA-01-40-AVA-2-2.

TERMINAL OBJECTIVE

(This objective is partially supported by this lesson topic

- 2.0 PERFORM an operational check of an aircraft liquid oxygen system, under supervision, in accordance with NA 01-40AVA-2-4. Record the maintenance action on appropriate source document(s), in accordance with OPNAVINST 4790.2 (series). All entries must be legible and correct. Control procedures and safety precautions must be observed in accordance with OPNAVINST 4790.2 (series) and 5100.10 (series).

ENABLING OBJECTIVES:

(This objective is partially supported by this lesson topic

- 2.4 MAINTAIN tool control procedures as outlined in the OPNAVINST 4790.2 (series) current instruction, document actions in accordance with Job Sheet.

(These objectives are supported entirely by this lesson topic

- 2.1 PERFORM a daily/preoperational inspection of a TMU-70 liquid oxygen servicing trailer, under supervision, in accordance with NA 19-25D-26.
- 2.1.19 SELECT, from a given list, the purpose of the TMU-70 Close-loop liquid oxygen storage tank.
- 2.1.20 SELECT, from a given list, the three major components of the TMU-70/M Trailer.
- 2.1.21 SELECT, from a given list, six safety precautions to be observed when working with liquid oxygen.
- 2.1.22 Using a TMU-70/M Schematic, TRACE the procedure to be followed when filling the TMU-70/M.
- 2.1.23 MATCH, from a list, the components of the TMU-70/M with their purposes or descriptions.
- 2.2 SERVICE an aircraft liquid oxygen converter, under supervision, in accordance with NA 01-40-AVA-2-2 and 19-25-D-26. A maximum of two errors will be allowed.

MAINTENANCE OF AN AIRCRAFT LIQUID OXYGEN SYSTEM

TERMINAL OBJECTIVE

This objective is partially supported by this lesson topic.)

- 1.0 PERFORM an operational check of an aircraft liquid oxygen system, under supervision, in accordance with NA 01-40AVA-2-4. Record the maintenance action on appropriate source document(s), in accordance with OPNAVINST 4790.2 (series). All entries must be legible and correct. Tool control procedures and safety precautions must be observed in accordance with OPNAVINST 4790.2 (series) and 5101.2 (series).

ENABLING OBJECTIVES:

These objectives are supported partially by this lesson topic.

- 1.1 PERFORM a daily/preoperational inspection of a TMU-70/M liquid oxygen servicing trailer, under supervision, in accordance with NA 19-250-26.
- 1.2 SERVICE an aircraft liquid oxygen converter, under supervision, in accordance with NA 02-40-AVA-2-2 and NA 19-240-26. A maximum of two errors will be allowed.
- 1.3 MATCH, from given lists, the names of the components of aircraft liquid oxygen system with their purposes, in accordance with NA-01-40-AVA-2-2.

These objectives are entirely supported by this lesson topic)

- 1.24 SELECT, from a given list, the acceptable amount of LOX that may be lost through evaporation in one 24 hour period.
- 1.25 SELECT, from a given list, the purpose of a functional test of a liquid oxygen system.
- 1.26 MATCH, from a list, the major procedural steps, in sequences, to use when filling an aircraft liquid oxygen system.
- 1.27 SELECT, from a given list, five safety precautions in handling of liquid oxygen.

MAINTENANCE OF SHOP SUPPORT EQUIPMENT

FINAL OBJECTIVE: None.

TRAINING OBJECTIVES

These objectives are partially supported by this lesson topic)

1. PERFORM routine maintenance and cleaning of classroom and shop equipment in accordance with course instructions.
2. MAINTAIN tool control procedures as outlined in the OPNAVINST 4790.2 (series) current instruction, documenting actions in accordance with Job Sheet.

INTRODUCTION TO OXYGEN AND NITROGEN

REFERENCES:

Maintenance Planning Manual, Navy Models F-4B, F-4J, and RF-4B Aircraft, NW01-245FDB-2-0, 1 January 1967.

Handbook of Operation, Service, and Repair Instructions with Parts Breakdown, High Pressure and Liquid Nitrogen Service Vehicle, NW19-25E-19, 1 June 1960.

Aviation Structural Mechanic E 3 & 2, NAVEDTRA 10309-D, Chapters 10 pages 10-1 through 10-5 and 10-20.

Aviation Crew System Oxygen Equipment, NAVAIR 13-1-6.4.

Gas Cylinders, (Storage Type) Use, Handling and Maintenance Manual, AN06-20-2, 25 June 1956.

Programmed Instruction Booklet, "Introduction to Oxygen and Nitrogen", CNTT-P-5190-PAT.

TAKING OUTLINE

ATMOSPHERIC CONDITIONS

1. Composition of atmosphere

Atmosphere is the body of gases surrounding the earth composed of, by volume, _____ nitrogen, _____ oxygen and 1% other gases.

2. Pressure

- a. Atmospheric pressure at sea level is _____ p.s.i. Oxygen comprises _____ of the atmosphere by weight.
- b. Thus the partial pressure of oxygen at sea level is three p.s.i., which is necessary to sustain life.

NOTE: $(.23 \times 14.7 = 3)$ Oxygen percentage of volume times atmospheric pressure equals oxygen partial pressure.

3. Effects on human body

- a. With an increase in altitude, the partial pressure of oxygen _____.
- b. A deficit of oxygen in the blood is known as _____.

- d. A rapid ascent to a higher altitude with resulting exposure to lowered air pressure is called _____ (air bends).

B. OXYGEN

1. Types

a. Type I, gaseous

(1) Grade A aviator's breathing

(a) Oxygen is delivered in _____ painted cylinders with a two inch wide white band.

(b) Specification requires this grade to be 99.99% pure.

(2) Grade B medical-industrial

Medical-industrial oxygen is delivered in green painted cylinders with white tops.

(3) Grade C technical-cutting and welding

Technical-cutting and welding oxygen is delivered in cylinders painted entirely green.

b. Type II, liquid

It is stored in vacuum insulated containers at or below its boiling point of minus _____.

NOTE: Type I, Grade A gaseous and Type II, liquid oxygen are the only type of oxygen used for aviators breathing.

2. Characteristics

a. Physical conditions

(1) Gaseous

Gaseous oxygen is _____, _____, tasteless, and forms about 1/5 of the atmosphere by volume.

(2) Liquid

(a) Liquid oxygen is pale blue in color and weighs approximately 9.6 pounds per gallon.

b. Contamination

(1) Source

Oxygen readily combines with other gases, odors from equipment, or the air from which oxygen is manufactured.

(2) Limits

Detection of any odor, however small, is reason to suspect it of being contaminated.

(3) Corrections

Contamination is eliminated by _____ with pure oxygen or hot water pumped nitrogen.

c. Reaction with fire

(1) Oxygen in itself is noncombustible but will support combustion.

(2) Material that will burn in air will burn with great speed and heat with pure oxygen.

d. Reaction with hydrocarbons

(1) Oxygen is very dangerous and explosive when brought into contact with any hydrocarbon (liquid or solid compound of carbon and hydrogen).

(2) A test for hydrocarbons is required on all oxygen storage containers.

e. Uses in naval aircraft

(1) Purpose

Provides the pilot and crew with sufficient oxygen under all _____ to enable them to

(a) Oxygen must be used on all flights above _____ feet.

(b) It is used on all night flights from the ground up to improve vision.

(c) Squadrons with jet aircraft use oxygen from the ground up.

f. Procurement

(1) Gaseous

(a) Gaseous oxygen is measured and ordered by _____ and received in storage cylinders.

(b) The size is determined by the operational use.

(c) Aboard ship oxygen is available through plumbing from the ship's manufacturing plant.

(2) Liquid

(a) Liquid oxygen is measured and ordered by the _____.

(b) It is stored in vacuum insulated containers.

(c) On shore stations, liquid oxygen is usually ordered from commercial activities.

(d) Aboard larger ships it is manufactured on board.

NITROGEN

. Characteristics

a. Nitrogen is an inert gas, lighter than air and will not support life or _____.

b. Because of nitrogen's inert characteristics, personnel should avoid breathing the gas to prevent oxygen starvation.

Physical conditions

a. Gaseous

(1) Gaseous nitrogen is colorless, odorless, and tasteless.

D. Liquid

Liquid nitrogen is clear in color and is stored in vacuum insulated containers at or below its boiling point of minus _____.

3. Used in naval aircraft

a. Gaseous

(1) Water pumped

(a) Water pumped (dry) nitrogen is used to _____ oxygen systems, thereby decreasing the moisture content in the systems.

(b) This will prevent freezing temperatures from _____ the system with ice.

(c) Water pumped cylinders are identified by _____ cylinder with two, two inch black bands.

(2) Oil pumped

(a) Oil pumped nitrogen is used in pneumatic cylinders instead of air and for the expansion agents such as fire extinguishing agents.

(b) Oil pumped cylinders are identified by _____ cylinder with a two inch black band.

NOTE: Never use oil pumped nitrogen to _____ oxygen systems.

(3) Liquid

Liquid nitrogen is used as a means of cooling electronic equipment in some aircraft.

SAFETY PRECAUTIONS

1. Operational

a. Oxygen

(1) Gaseous

(a) Never allow oxygen to come into contact with hydrocarbons.

(b) Never operate equipment unless you understand

(d) Never use other than approved cleaning agents on oxygen equipment.

(2) Liquid

- (a) Always wear protective clothing when working around liquid oxygen.
- (b) Never allow liquid oxygen to come in contact with the body or be trapped in clothing.
- (c) Keep liquid oxygen clear of all hydrocarbons.

b. Nitrogen

(1) Gaseous

- (a) Do not breathe nitrogen.
- (b) Do not use oil-pumped nitrogen in or around oxygen equipment.

(2) Liquid

- (a) Never allow nitrogen to vent in a closed space.
- (b) Never allow nitrogen to come in contact with the body.

2. Transporting

a. Oxygen

(1) Gaseous

- (a) When transporting in trucks, storage cylinders should be secured together in an _____ position.
- (b) Never permit storage cylinders to be handled with electromagnets, rope or chain slings.

(2) Liquid

- (a) Ensure storage containers are properly secured.
- (b) Never transport liquid oxygen in a sealed container.

b. Nitrogen

(1) Gaseous

- (b) Never handle cylinders with a chain or rope sling.

(2) Liquid

- (a) Ensure liquid containers are properly secured
- (b) Never transport liquid nitrogen in a closed container.

3. Storing

a. Oxygen

(1) Oxygen

- (a) Do not store near any extreme source of heat.
- (b) Store oxygen away from inflammable materials.
- (c) Store _____ and _____ cylinders separately.
- (d) Assure free ventilation in storage building.
- (e) No smoking within _____ of storage area.

(2) Liquid

- (a) Assure free ventilation in any compartment where liquid oxygen containers are stored and that containers are vented to prevent _____.
- (b) No smoking in or around a liquid oxygen compartment.
- (c) Storing compartment shall be cleaned and isolated from hydrocarbons and hydrocarbon fumes.

b. Nitrogen

(1) Gaseous

- (a) Store empty and full cylinders separately.
- (b) Ensure free ventilation to prevent concentration of gas.

(2) Liquid

1. Keep oil and grease off oxygen equipment.
2. Never handle oxygen or oxygen equipment with greasy hand tools, or clothing.
3. Never let fittings, hose, or any oxygen equipment get smeared with oil, grease, hydraulic fluid, or dirt.
4. Cylinders shall never be used for gases or liquid other than that indicated by the cylinder markings. Hydrogen or other hydrocarbon gas will cause a serious explosion if mixed with oxygen.
5. Never permit oxygen cylinders to come in contact with an electrical welding circuit or apparatus.
6. Do not allow sparks or flames from a welding or cutting torch or any other source to contact cylinders.
7. Never use oxygen from a cylinder without reducing the pressure through a regulator or pressure reducer.
8. Never test for line leaks or blown-up lines with oxygen, unless lines are specifically made and cleaned for oxygen use.
9. Never use oxygen for pneumatic tools; for starting diesel engines; as a pressure agent in an oil reservoir; for paint spraying; or for any use other than breathing, welding, cutting, and testing oxygen equipment.
10. Oxygen must not be stored or used near flammable material or any substance likely to start or accelerate fire. Oxygen is not inflammable but it supports combustion with intensity.
11. Oxygen cylinders must not be stored with hydrogen or other combustible gas cylinders in an unventilated place. If stored inside, they should be separated by a fire-resistant wall.
12. Do not store oxygen cylinders and apparatus under moving machinery, cranes, or bolts. Oil may drop and cause an explosion and fire.
13. Do not use nitrogen transfer pumps for transferring oxygen.
14. Oxygen cylinders shall be maintained at a temperature not exceeding 49° C. (120° F.).

FIGURE 3.1-1 Safety Precautions For Handling Gaseous Oxygen

15. Cylinders will never be used as rollers, supports, any purpose other than for the transportation of compressed gases, even though they are empty. Use of cylinders for any unauthorized purpose may result in valve damage, dirt contamination which, in turn, would be contributory factors to future accidents and danger to personnel.
16. Compressed gases will never be used to dust off clothing as serious injury to the eyes and body may result.
17. Pry bars must never be used under valves or valve connections to pry cylinders loose when frozen or fixed to the ground.
18. Valve protective caps, if frozen, shall be thawed in a warm room. Do not use a steam hose to thaw them as the fusible safety plugs may melt and allow discharge of cylinders.
19. Cylinders must be protected against excessive rise of temperature. Cylinders will be stored inside whenever possible, and, if not, they may be stored in the open; they must be protected from extreme weather conditions and also from the ground to prevent rusting.
20. Cylinders stored in the open must be protected from accumulation of ice and snow. In the summer, cylinders stored in this manner will be protected or screened from direct rays of the sun.
21. Never fill a low-pressure system from a high-pressure source without a pressure reducer and a frangible safety disc, which is designed to burst at the maximum allowable pressure in the low-pressure system.
22. Never fill oxygen cylinders which have an expired hydrostatic test date (five years).
23. Only qualified operators shall operate recharge equipment.

PHYSICAL CHARACTERISTICS OF LIQUID OXYGEN

LIQUID OXYGEN, COMMONLY KNOWN AS "LOX", IS PALE BLUE IN COLOR, FLOWS LIKE WATER, AND WEIGHS 8.5 POUNDS PER GALLON. "LOX" IS EXTREMELY COLD, FREEZING INTO GASEOUS OXYGEN AT ATMOSPHERIC PRESSURE AT A TEMPERATURE OF -297°F . THE LIQUID HAS A VOLUME EXPANSION RATIO OF 862 TO 1, WHICH MEANS THAT A GALLON OF LIQUID WILL EXPAND 862 TIMES WHEN CONVERTED TO A GAS AT ATMOSPHERIC PRESSURE. "LOX" HAS A DENSITY OF 1.14 GRAMS PER CC AND ITS LATENT HEAT OF VAPORIZATION IS 50.9 CALORIES PER GRAM.

SAFETY PRECAUTIONS

AVOID TOUCHING BARE METAL LINES CONTAINING "LOX" AS BARE SKIN WILL INSTANTLY FREEZE TO THE METAL.

WHEN A COMPLETELY EMPTY SYSTEM IS SERVICED, "LOX" MUST BE ADDED SLOWLY TO COOL THE SYSTEM DOWN TO THE -279°F STORAGE TEMPERATURE. EQUIPMENT MAY BE DAMAGED BY THERMAL SHOCK IF EXCESS PRESSURE IF THE "LOX" IS FORCED IN TOO RAPIDLY.

CAUTION NEVER SEAL "LOX" IN AN UNVENTED CONTAINER. "LOX" SEALED OFF AT ROOM TEMPERATURE WILL DEVELOP A PRESSURE OF MORE THAN 12,000 PSI.

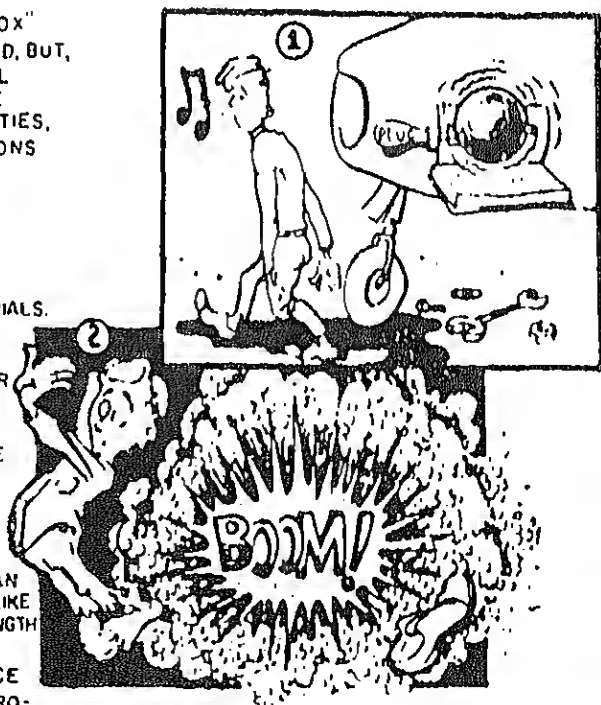
WARNING DON'T GET CARRIED AWAY WITH YOUR WORK. LIKE SOME OTHER AIRCRAFT SYSTEMS, THE "LOX" SYSTEM CAN BE DANGEROUS AND MUST BE RESPECTED, BUT, IT IS UNDERSTOOD CERTAINLY NOT FEARED. PERSONNEL DESIGNATED TO SERVICE THE "LOX" SYSTEM MUST BE THOROUGHLY FAMILIAR WITH LIQUID OXYGEN PROPERTIES, AND SKILLED IN ITS USE. THE FOLLOWING PRECAUTIONS MUST BE ADHERED TO WHEN HANDLING "LOX".

SAFETY PRECAUTIONS

NEVER STORE OR HANDLE "LOX" IN A POORLY VENTILATED AREA OR CLOSE TO INFLAMMABLE MATERIALS. ORGANIC MATERIALS SUCH AS CLOTHING, CIGARETTES AND OILS, WHEN SPLASHED WITH LOX, WILL BURN INSTANTLY IF IGNITED WITHIN SEVERAL MINUTES AFTER EXPOSURE. FLAMES, SPARKS, BURNERS, HEATERS AND AUTOS MUST BE KEPT AWAY FROM "LOX" STORAGE TANKS, PORTABLE UNITS AND THE AIRPLANE WHILE IT IS BEING TRANSFERRED.

DO NOT SUBSTITUTE EQUIPMENT WHICH IS PROVIDED FOR HANDLING "LOX". THE PHYSICAL PROPERTIES OF MANY MATERIALS ARE QUITE DIFFERENT WHEN AT -297°F THAN WHEN THEY ARE AT ROOM TEMPERATURE. RUBBER SHATTERS LIKE GLASS, SOME METALS GET BRITTLE AND LOSE THEIR STRENGTH.

THE EXTREME COLD OF "LOX" WILL INSTANTLY PRODUCE PAINFUL BURNS IF HELD IN CONTACT WITH THE SKIN. PROTECTIVE EQUIPMENT, CONSISTING OF A SUITABLE FACE MASK, APRON AND GLOVES MUST BE WORN WHEN HANDLING "LOX".



● Personnel designated to service the system must be thoroughly familiar with liquid oxygen properties and filled in its use.

● Never seal liquid oxygen in an unvented container. sealed off at room temperature, it can develop a pressure of more than 12,000 psi.

● Do not use antiseize and thread sealing compound on flared tube connections.

● Never apply compound on flare to prevent leakage.

● Keep all oxygen equipment, lines, and fittings free from grease, dirt, oil, and leaks.

● Use anti-icing fluid (MIL-F-5566) for cleaning the outside of metal parts and lines.

● Use a mild soap solution (MIL-S-4282) for cleaning rubber parts and for leak testing the oxygen system.

● The liquid oxygen converter is a high vacuum "thermos" type. Extreme care should be exercised to avoid damaging the converter by striking sharp objects.

● Never store or handle oxygen in a poorly ventilated area or close to flammable materials.

● Organic materials such as clothing, cigarettes, and pens, when splashed with liquid oxygen, will burn violently if ignited within several minutes after exposure.

● Flames, sparks, burners, heaters, and exhausts must be kept away from storage vessels, portable units, and the aircraft while fluid is being transferred.

● Do not substitute equipment which is provided for handling liquid oxygen. The physical properties of many materials are quite different at -183°C (-297°F) from their properties at room temperature. At such extreme cold, rubber shatters like glass; some materials get brittle and some lose their strength, etc.

● Protective equipment consists of a suitable face shield, apron, and gloves which must be worn when handling liquid oxygen. If liquid oxygen accidentally comes in contact with personal clothing, the clothing

● In case of body contact, or if there is reason to suspect that a part of the body has been frozen or chilled, seek medical aid immediately. Do not touch any of the liquid oxygen system metal lines with bare hands; the skin will freeze instantly.

● When transferring liquid oxygen, ensure adequate ventilation by opening all available ports and hatches. Never use, or attempt to use, 1800 psi gaseous oxygen transfer equipment to transfer liquid oxygen, or vice versa. Never use oxygen equipment to store or transfer any other gas or liquid.

● When recharging an aircraft oxygen system, ensure that the aircraft is in an open area, is not being fueled, is properly grounded, and has no internal or external power on.

● When handling liquid oxygen, ensure that extinguishing equipment is readily available, that personnel are clear of the vent area and that the immediate vicinity of the vent area is free from grease or any other combustible material.

● Liquid oxygen spillage should be avoided. In the event of accidental spillage, the area should be thoroughly ventilated.

● When transferring liquid oxygen, open valves slowly, then close about one-quarter turn. This will preclude the possibility of the valve freezing in the wide open position.

● Tools and clothing must be free of oil and grease.

● Do not carry "strike anywhere" matches in liquid oxygen handling areas.

● Moisture must not be introduced into the system. Ensure that no moisture is present on filler valves or filler nozzle before they are connected.

ASSIGNMENT SHEET 3.1.1A

INTRODUCTION TO OXYGEN AND NITROGEN

PRODUCTION

To understand oxygen and nitrogen and their uses, a look at the atmosphere must be taken. The air we breathe is not all oxygen, carbon dioxide, or nitrogen; it is a mixture of gases. The act in the atmosphere is oxygen, which is essential to our bread without it animal life would cease to exist.

TERMINAL OBJECTIVE

supported partially by this lesson topic:

0

ABLING OBJECTIVES

supported partially by this lesson topic:

1, 2.2, 2.3

supported entirely by this lesson topic:

1.1 through 2.1.13

UDY ASSIGNMENT

Review Notetaking Sheet 3.1.1N.

Read Aviation Structural Mechanic E 3 & 2 Manual, NAVEDTRA 10309-D. Chapter 10, pages 10-1 through 10-5 and page 10-2

Complete program instruction "Introduction to Oxygen and Nitrogen, CNATT-P-5190 PAT".

UDY QUESTIONS

Answer the following questions by circling the right letter letters.

Select the percentages of the gases that make up the atmosphere.

- 78 percent nitrogen, 21 percent oxygen, and 1 percent other gases.
- 79 percent oxygen, 21 percent other gases, and 1 percent nitrogen.

gases.

The partial pressure of oxygen at sea level is

- a. 21 psi.
- b. 14.7 psi.
- c. 23 psi.
- d. 3 psi.

Match each of the three physical conditions caused by oxygen starvation or decreasing atmospheric pressure, listed in column A, with its description listed in column B.

A	B
____ (1) Hypoxia	a. A complete depletion of oxygen in the bloodstream which results in death.
____ (2) Anoxia	b. An increase in atmospheric pressure, which causes the bends.
____ (3) Aeroembolism	c. A deficiency of oxygen in the bloodstream, which may cause drowsiness, impaired memory or blurred vision.
	d. A decrease in atmospheric pressure, which causes the nitrogen in the bloodstream to expand, producing pain in the joints and itching skin.

Select the four characteristics of gaseous oxygen.

- a. Odorless.
- b. Pale blue.
- c. Tasteless.
- d. Colorless.
- e. Has a slight odor.
- f. Forms about 1/5 of the atmosphere by volume.

Select the four characteristics of liquid oxygen.

- a. Boils at a temperature of -297°F (-183°C).
- b. Colorless.
- c. Weighs approximately 9.6 pounds per gallon.
- d. Strong affinity for liquid nitrogen.
- e. Expands at ratio of 862:1.
- f. Boils at a temperature of -320°F (-904°C).
- g. Pale blue.

Select the two types of oxygen used in naval and Marine Co aircraft.

- a. Type B, gaseous
- b. Type I, gaseous
- c. Type A, liquid
- d. Type II, liquid

Match each of the three grades of gaseous oxygen, listed in column A, with its name and description listed in column B.

A

B

____ (1) Grade A.

____ (2) Grade B.

____ (3) Grade C.

- a. Aviators' breathing oxygen--99.5 percent pure and stored in a green cylinder with a 2-inch wide band.
- b. Industrial, cutting, and welding oxygen--stored in a blue cylinder that is painted entirely blue.
- c. Medical-technical oxygen--stored in a green cylinder with a white top.

8. Select the three flight requirements for the use of oxygen in naval and Marine Corps aircraft.
- Oxygen must be used on all night flights above 18,000 feet.
 - Oxygen must be used from the ground up in all flights.
 - Oxygen must be used from the ground up on all night flights in order to improve vision.
 - Oxygen must be used from the ground up in jet aircraft in the day and in the night.
 - Oxygen must be used on all flights above 10,000 feet.
9. Select four of the six basic safety precautions that must be observed when gaseous oxygen is used.
- Never allow oxygen to come into contact with hydrocarbons.
 - Oxygen cylinders should be laid flat when they are transported.
 - Do not smoke within 50 feet of an area where oxygen is stored.
 - Never handle oxygen-storage cylinders with electromagnetic ropes, or chain slings.
 - Store oxygen in a closed space only.
 - When oxygen cylinders are transported, they should be secured together in an upright position.
 - Do not store oxygen near sources of extreme heat.
 - Do not smoke within 100 feet of an area where oxygen is stored.
 - Store oxygen in a well ventilated area.
10. Select four of the five basic safety precautions to observe when handling and storing liquid oxygen.
- Always wear protective clothing when working around liquid oxygen.
 - Never allow liquid oxygen to come in contact with air.
 - Ensure that storage compartments and containers are properly ventilated in order to prevent pressure from building up.

- f. Never allow liquid oxygen to come in contact with the body. It will be trapped in clothing.
 - g. Liquid-oxygen containers must be stored at a temperature of -183°C or below.
 - h. Keep liquid oxygen clear of all hydrocarbons.
- . Select four of the five characteristics of gaseous nitrogen.
- a. Tasteless.
 - b. Heavier than air.
 - c. Lighter than air.
 - d. Will not support life and is not combustible.
 - e. Colorless.
 - f. Odorless.
 - g. Has a slight odor.
 - h. Clear in color.
 - i. Unstable in its gaseous state.

. Match each of the three types of nitrogen, listed in column A, with its use and description listed in column B.

A

B

- ___ Water-pumped (dry) nitrogen.
- ___ Oil-pumped nitrogen.
- ___ Liquid nitrogen.

- a. Used in pneumatic cylinders as an expulsion agent. Stored in a cylinder that is painted gray with a two inch black band around it.
- b. Used to purge oxygen systems. Stored in a cylinder that is painted gray with two, two inch black bands around it.
- c. Used to cool electronic equipment in some aircraft. Stored in a vacuum insulated container.
- d. Used to purge hydraulic systems. Stored in a cylinder.

Select five of the six basic safety precautions to observe when handling and storing gaseous and liquid nitrogen.

- a. Do not smoke within 50 feet of nitrogen-storage areas.
- b. Do not breathe nitrogen.
- c. Do not use oil-pumped nitrogen in or around oxygen equipment.
- d. Do not store nitrogen with flammable materials.
- e. Never transport liquid nitrogen in a vented container.
- f. Ensure that liquid-nitrogen containers are properly vented in order to prevent pressure from building up.
- g. Ensure that nitrogen-storage areas are properly ventilated.
- h. Do not allow nitrogen to come in contact with hydrocarbons.
- i. Never allow liquid nitrogen to come in contact with the body.
- j. Never handle a gaseous-nitrogen cylinder with a chain or a rope sling.

FAMILIARIZATION WITH AIRCRAFT LIQUID OXYGEN SYSTEMS

REFERENCES:

1. Handbook, Maintenance Instruction, Navy Models A-4A and A-4B Aircraft, NW 01-40AVA-2-4, 15 November 1969, Section IV, Systems, pages 4-94 through 4-117.
2. Maintenance Instructions Manual, Navy Models F-4A, F-4B, and RF-4B Aircraft, General Airframe Information, NW 01-245FDB-2-2-1, 1 April 1969, Section III, Liquid Oxygen Systems, pages 3-10 and 3-13.
3. Aviation Structural Mechanic "E" 3 & 2, NAVEDTRA 10309-D, Edition, Chapter 10, Oxygen Systems, pages 10-4 through 10-16 through 10-20.

NOTETAKING OUTLINE:

1. Advantages of liquid oxygen systems:

1. A liquid oxygen system operates at a relatively low pressure operating at maximum of _____.
2. Liquid oxygen expansion ratio of 862 to 1 greatly increases the oxygen duration.
3. At the same time it saves space and weight by allowing a converter to replace several gaseous oxygen cylinders.

2. Types of systems:

1. Low pressure 65 to 75 p.s.i.
Low flow _____ liters per minute.
2. Low pressure 65 to 75 p.s.i.
Medium flow _____ liters per minute.
3. High pressure 350 p.s.i. (maximum)
High flow _____ liters per minute.

3. Components & Operation

NOTE: The following specified pressure pertains to the A-4 aircraft only. Pressure ranges will vary with different aircraft.

1. Converters

b. The size of the converter depends on the number of personnel using it.

c. _____ and _____ liter converters are the common used.

d. Location of the converter varies with the aircraft manufacturer.

Liquid oxygen differential check valve.

a. This valve is _____ to the closed position.

b. It is connected between the bottom of the converter (liquid side) and the supply line.

c. When pressure in the supply line drops to five p.s.i., below the pressure on the liquid side, the valve opens.

d. This allows a small amount of liquid oxygen to flow in the supply line.

e. By doing this, it _____ oxygen by metering it on demand.

f. It also prevents liquid from entering the heat exchanger during the _____.

Buildup/vent valves (see figure 3.2-1)

a. These valves permit liquid oxygen systems to be _____ during the filling process when placed in "vent" position.

b. They also _____ the pressure in the system when placed in "_____ " position.

c. Types

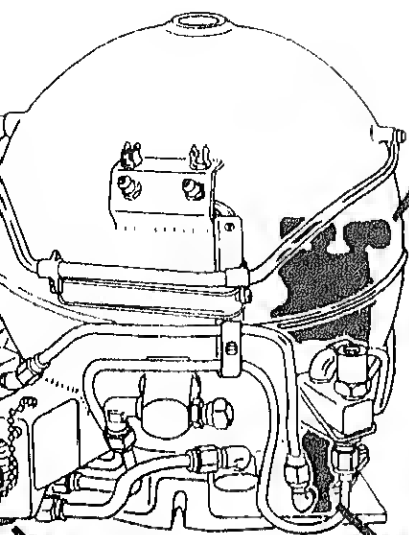
(1) Manual: On earlier systems a manual valve was used to place the system in "vent" and "buildup".

(2) Combination.

(a) On later installations a combination fill/buildup/vent valve is used.

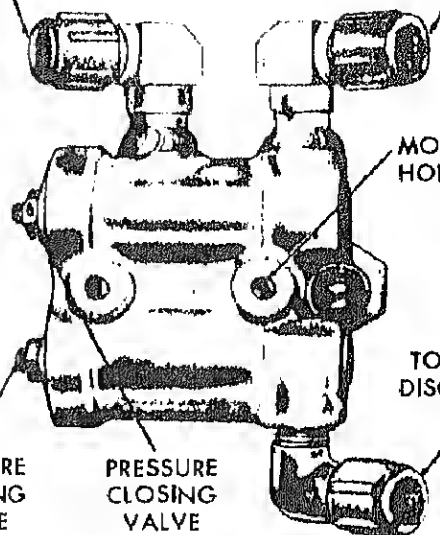
(b) This eliminates _____

d. Operation



TO FILL, VENT AND
BUILD-UP VALVE

TO



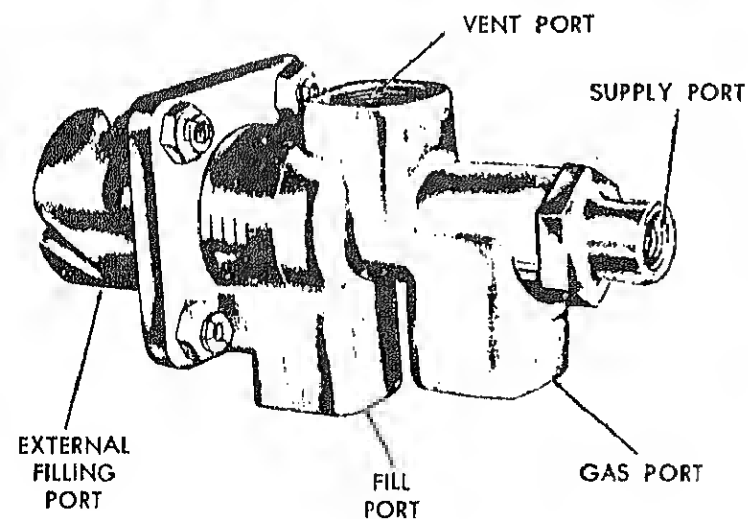
MO
HO

TO
DISC

PRESSURE
OPENING
VALVE

PRESSURE
CLOSING
VALVE

**COMBINATION PRESSURE OPEN
PRESSURE CLOSING VALVE**



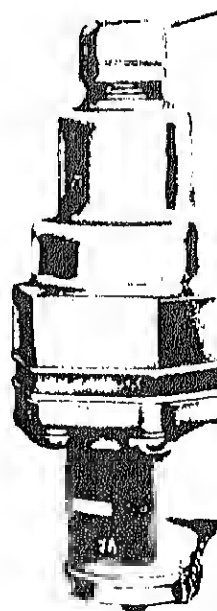
VENT PORT

SUPPLY PORT

EXTERNAL
FILLING
PORT

FILL
PORT

GAS PORT



RELIEF VA

- (b) In some aircraft the dust cap cannot be removed with the system in buildup, or it is impossible to close the access door before the handle is returned to buildup.

(2) Combination

- (a) This valve is spring loaded to the _____ position.
- (b) It is automatically vented when a filling adapter is attached to the filler valve.

4. Filler valve

a. Purpose

- (1) This valve is spring-loaded to the closed position, allows the filling of the converter, and keeps liquid oxygen escaping after the converter has filled.
- (2) This is a quick-disconnect fitting.

b. Operation

- (1) When the transfer hose of the servicing trailer is connected to the filler valve of the converter, check in the hose _____ that of the valve.
- (2) This permits the liquid to enter the converter.

5. Buildup coil

a. Purpose

- (1) A liquid oxygen system will not function without _____.
- (2) Pressure buildup is _____ and is accomplished by the buildup coil.

b. Operation

- (1) The _____ and/or pressure of liquid oxygen in the converter forces liquid oxygen out of the bottle into the pressure buildup coil.
- (2) The liquid oxygen absorbs heat which is transferred

Pressure closing valve

a. Purpose

- (1) This valve is known as the _____ of the liquid oxygen system.
- (2) It controls the normal operating pressure of the liquid oxygen system.

b. Description and location

This is a bellows operated valve connected in the system between the buildup vent valve and the pressure opening valve.

c. Operation

- (1) With the system unpressurized, the normal position the valve is _____.
- (2) The internal arrangement is such that at a converter pressure of _____ plus or minus (+) 2 p.s.i., the valve closes, allowing no gaseous oxygen to flow to the top of the converter.
- (3) With converter pressure less than _____ plus or minus (+) 2 p.s.i., the valve opens and allows gaseous oxygen to flow to the top of the converter keeping it at a constant _____ plus or minus (+) p.s.i..

Pressure opening valve

a. Purpose

This valve opens under pressure, controlling _____ operating pressure of the liquid oxygen system.

b. Description and location

This is a bellows operated valve, connected into the system between the pressure closing valve and the oxygen _____.

c. Operation

- (1) At a converter pressure of 80 p.s.i., plus or minus _____ p.s.i., this valve _____, allowing gaseous oxygen from the topside of the converter to enter _____.

- (3) As pressure is reduced below 80 p.s.i., plus (+) 1 p.s.i., the valve closes, closing off side of the converter to the supply line.

8. Low-pressure relief valve

a. Purpose

This valve relieves the converter of excessive by venting the excess gaseous oxygen overboard.

b. Description

(1) This valve is installed if the system between top of the converter and overflow vent line

(2) It is spring-loaded to the closed position.

c. Operation

(1) This valve is preset to open at a pressure p.s.i. plus or minus 10 p.s.i..

(2) This relieves the converter of excessive pressure.

9. Oxygen "on-off" switch and high pressure relief valve

a. Purpose.

(1) The _____ of oxygen to the oxygen mask regulator is controlled by manually selecting the "on" or "off" position.

(2) This switch is necessary because the pilot must be able to remove his mask from the aircraft once a flight is completed.

(3) There must be some means of controlling the oxygen flow.

(4) The high-pressure relief valve will relieve the pressure should the _____ fail.

(5) All aircraft will not employ an oxygen switch. All aircraft will have two relief valves.

b. Description.

- (1) The oxygen "on-off" switch and high-pressure relief valve is a three-port valve installed as an integral unit.
- (2) This unit consists of an _____, and _____.

c. Operation

- (1) By positioning the oxygen switch to "on", the outlet (supply) port is opened and allows gaseous oxygen to flow to the regulator.
- (2) Placing the switch to the "off" position closes the port.
- (3) The high-pressure relief valve is spring-loaded to the closed position and is preset to open at _____ plus or minus 5 p.s.i..

Quantity indicating system

a. Probe

This is a _____ element located inside the converter extending from the top of the converter to the bottom.

b. Preamplifier.

- (1) Preamplifier _____ electrical signal from the probe.
- (2) Electrical signal is then amplified and relayed to the _____.

c. Quantity indicator.

- (1) This unit receives signals from the preamplifier, indicating the quantity in terms of _____.
- (2) The amount of liters depends on the size of the converter.
- (3) Some quantity indicators will emply a low-level warning light that will automatically come on when a preset level is registered on the indicator.

- b. It may be constructed of aluminum tubing 50 aluminum sheets with a series of _____.
- c. Size of the heat exchanger determines the flow of oxygen.

D. Operation of a system

1. Filling system (see figure 3.2-2)

- a. With the build/up vent valve in "_____", under pressure from the portable servicing through the filler valve and into the converter the _____.
- b. As liquid level rises in the converter, the oxygen caused by normal "boil-off" is _____.
- c. When converter is completely filled, liquid oxygen through the buildup/vent valve overboard at _____.

2. Buildup cycle. (see figure 3.2-3)

- a. Pressure buildup begins when the buildup/vent valve is placed in the buildup position.
- b. Liquid oxygen from the converter fills the _____ by gravity feed.
- c. Heat transfer through the walls of the buildup coil vaporizes the liquid, causing the pressure to build up and circulate through the pressure _____ and back to the top of the converter. This causes the liquid to flow to the buildup coil.
- d. The pressure buildup continues until the pressure reaches _____ plus or minus 2 p.s.i., closing the pressure closing valve and stopping further buildup.

3. Stand-by cycle. (see figure 3.2-4)

- a. With the pressure closing valve closed and the pressure buildup valve open on the system, gaseous oxygen in the top of the converter continues to warm and expand until it reaches _____ plus or minus 1 p.s.i., opening the pressure closing valve.

a. Top (economy mode). (see figure 3.2-5)

- (1) A limited demand upon the system allows the _____ to supply gaseous oxygen directly to the _____ as a result of drawing off the gaseous oxygen within the top of the converter.
- (2) Continued demand _____ supply line pressure 80 plus or minus 1 p.s.i., causing the pressure opening valve to close.

b. Bottom (demand mode). (see figure 3.2-6)

- (1) After the pressure opening valve closes, full demand on the system continues to reduce the line pressure until it is 5 p.s.i. less than _____ pressure.
- (2) This 5 p.s.i. difference unseats the differential check valve and meters small amounts of liquid oxygen into the _____ where it is transferred to gaseous oxygen.
- (3) Converter pressure will build up while the system is in the demand mode until the pressure again approaches 80 plus or minus 1 p.s.i., opening the pressure _____ valve. This switches the sequence back into the economy mode.

E. Draining Converter.

NOTE: A defective converter containing liquid oxygen must be drained prior to being turned in to supply. Consult appropriate maintenance instructions manual for details.

CAUTION: When draining converter of liquid oxygen, ensure area is well ventilated and free of unnecessary personnel and that a fire extinguishing equipment is readily available. Drain only into a clean container of a suitable size and allow the liquid to evaporate.

1. Systems with manual buildup/vent valves.

- a. Place buildup/vent valve in "vent".
- b. Disconnect servicing hose at servicing trailer and place in receiving container. Then attach hose filler adapter to the converter filler valve.

- d. Place buildup/vent valve in "vent" after converted empty.

2. Systems with combination fill/buildup/vent valve.

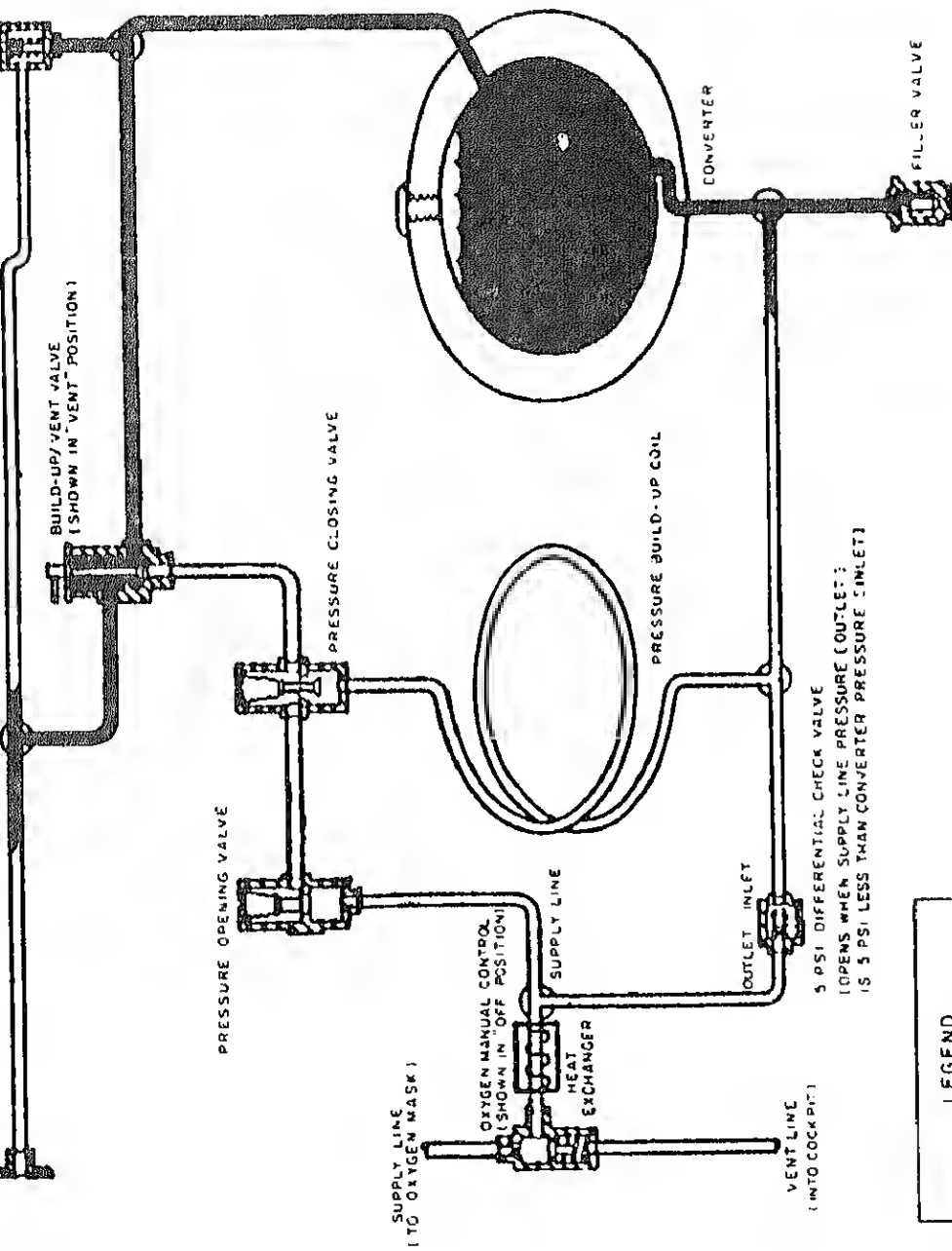
- a. Attach a drain line disconnect coupling to the con
supply disconnect coupling. This opens the check valve in t
to flow out of the drain line.

CAUTION: The liquid will be forced out by interna
pressure.

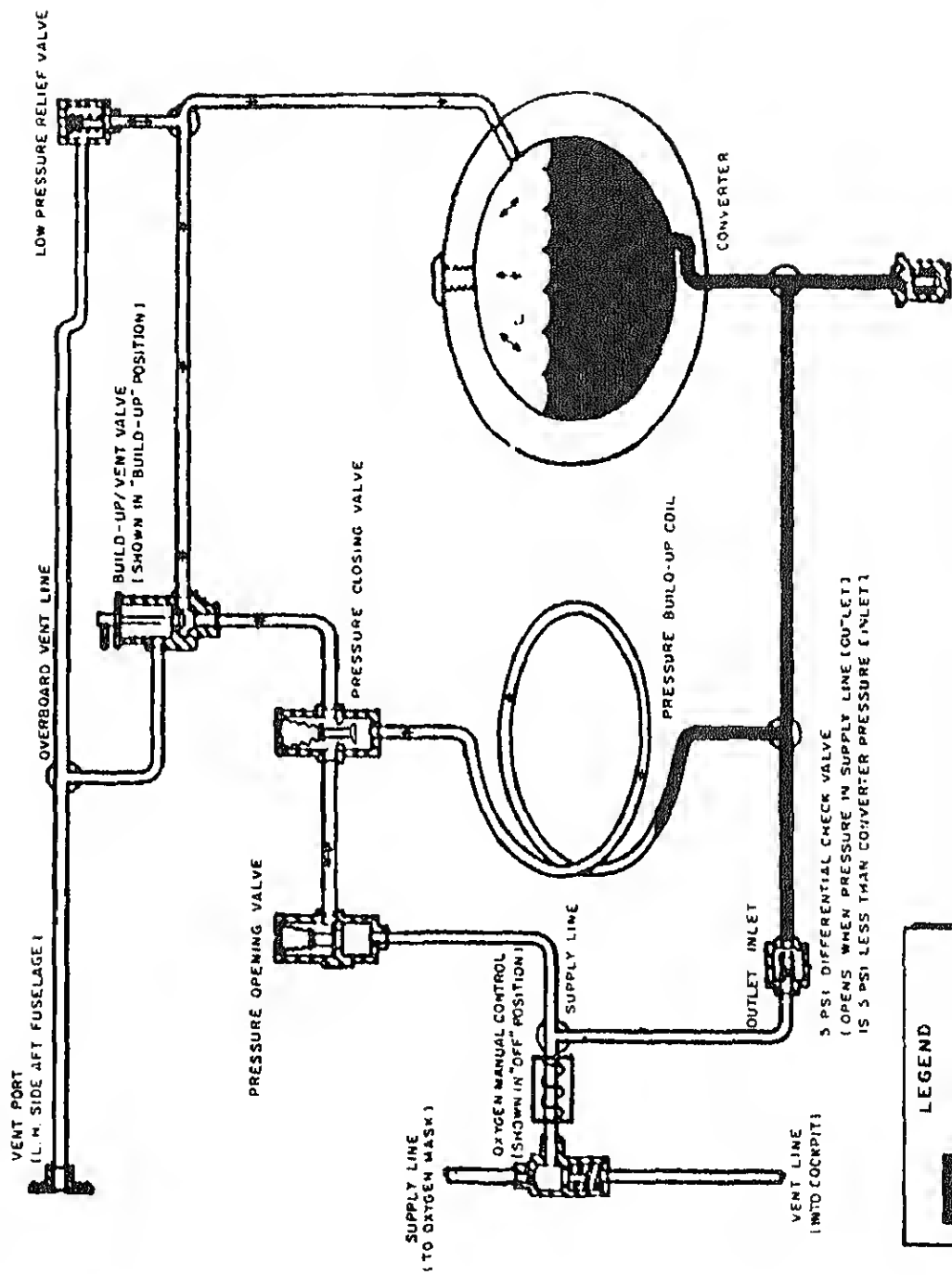
- b. When liquid oxygen no longer flows from the drain
remove the drain line disconnect coupling.

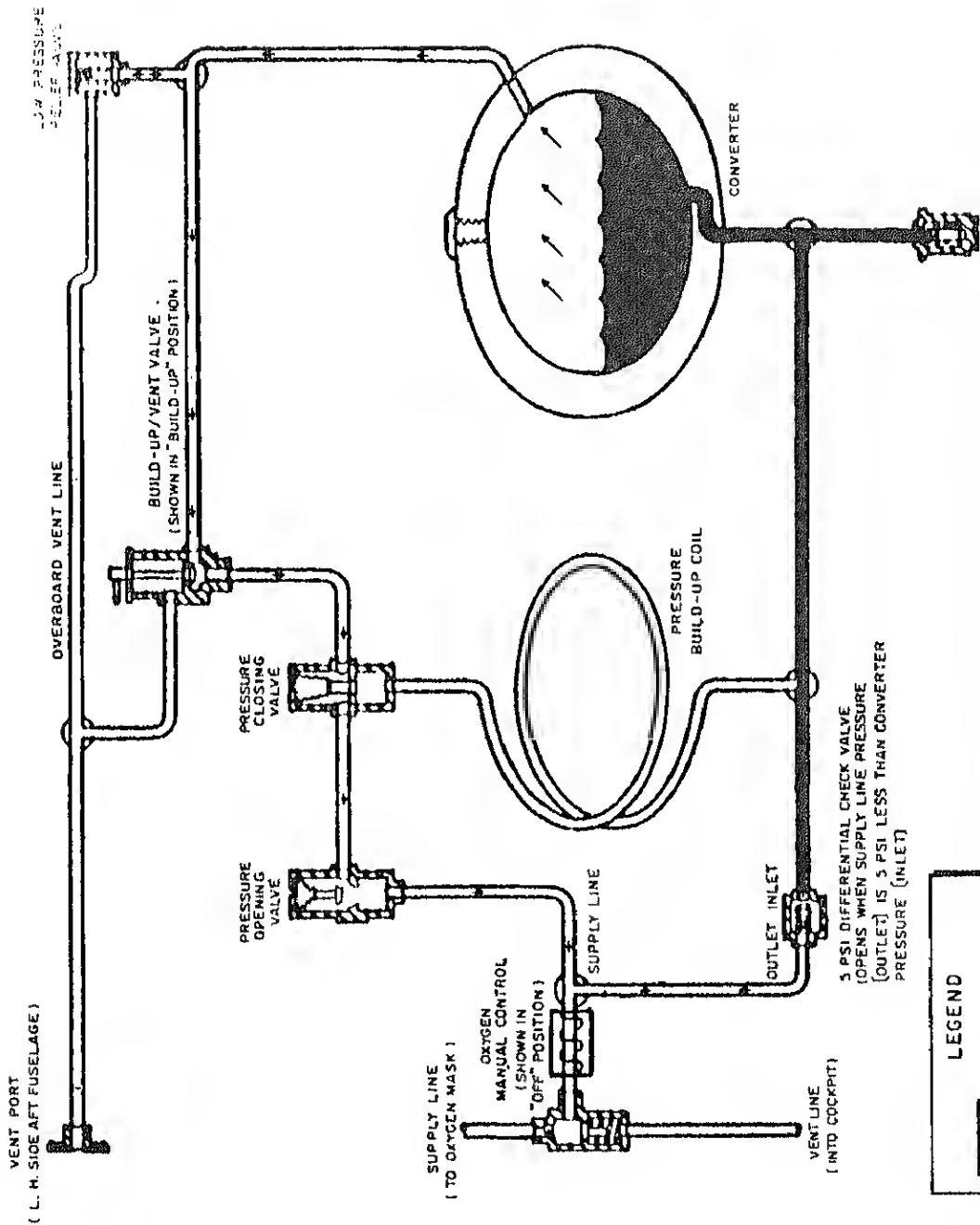
F. Safety precautions.

1. Ensure liquid oxygen is kept free of all hydrocarbons.
2. Always wear protective clothing when working with liqu
oxygen.
3. Allow no smoking within 50 feet of liquid oxygen.



LEGEND





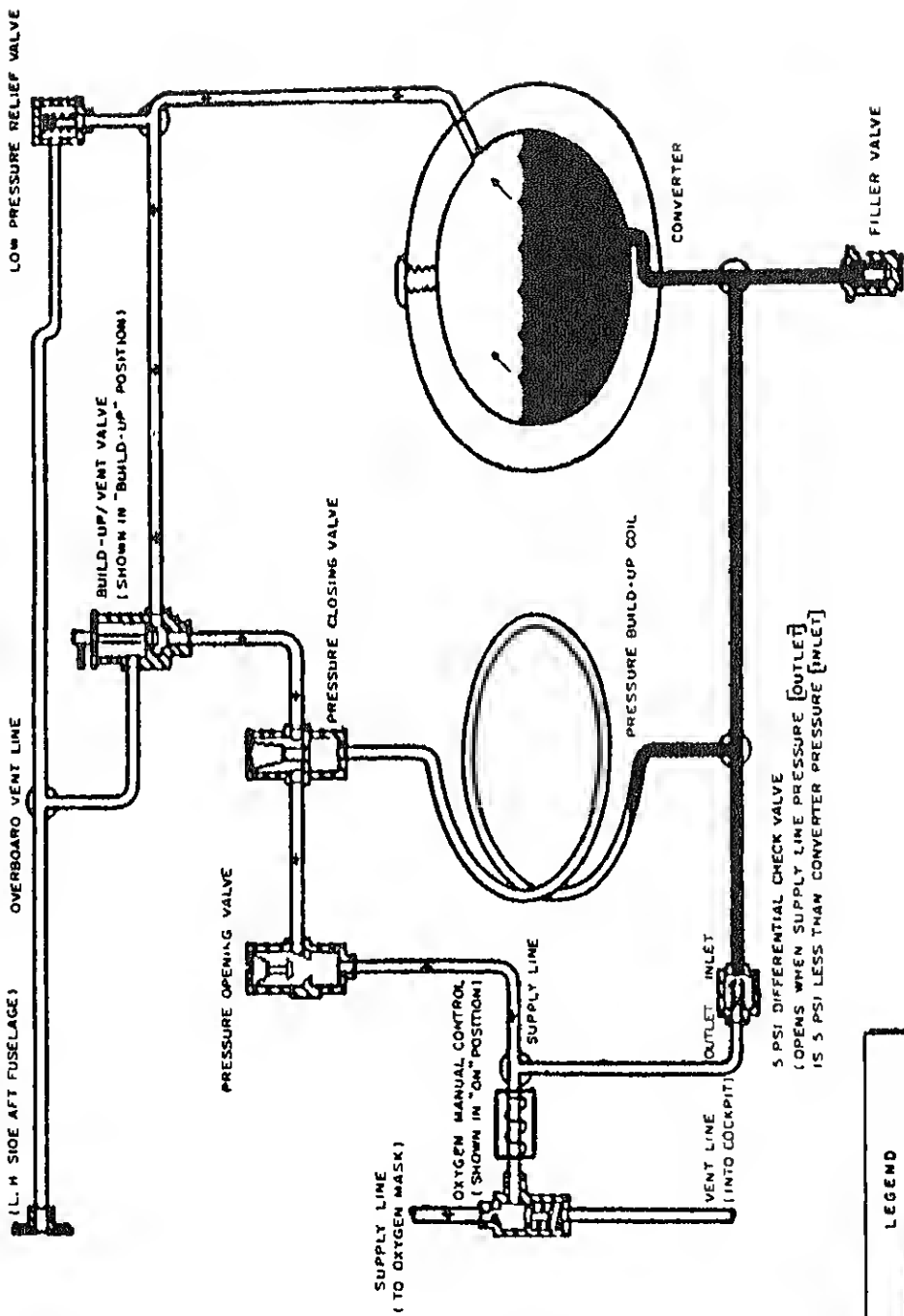


FIGURE 3.2-5--Liquid Oxygen Converter Operation (Economy Mode).

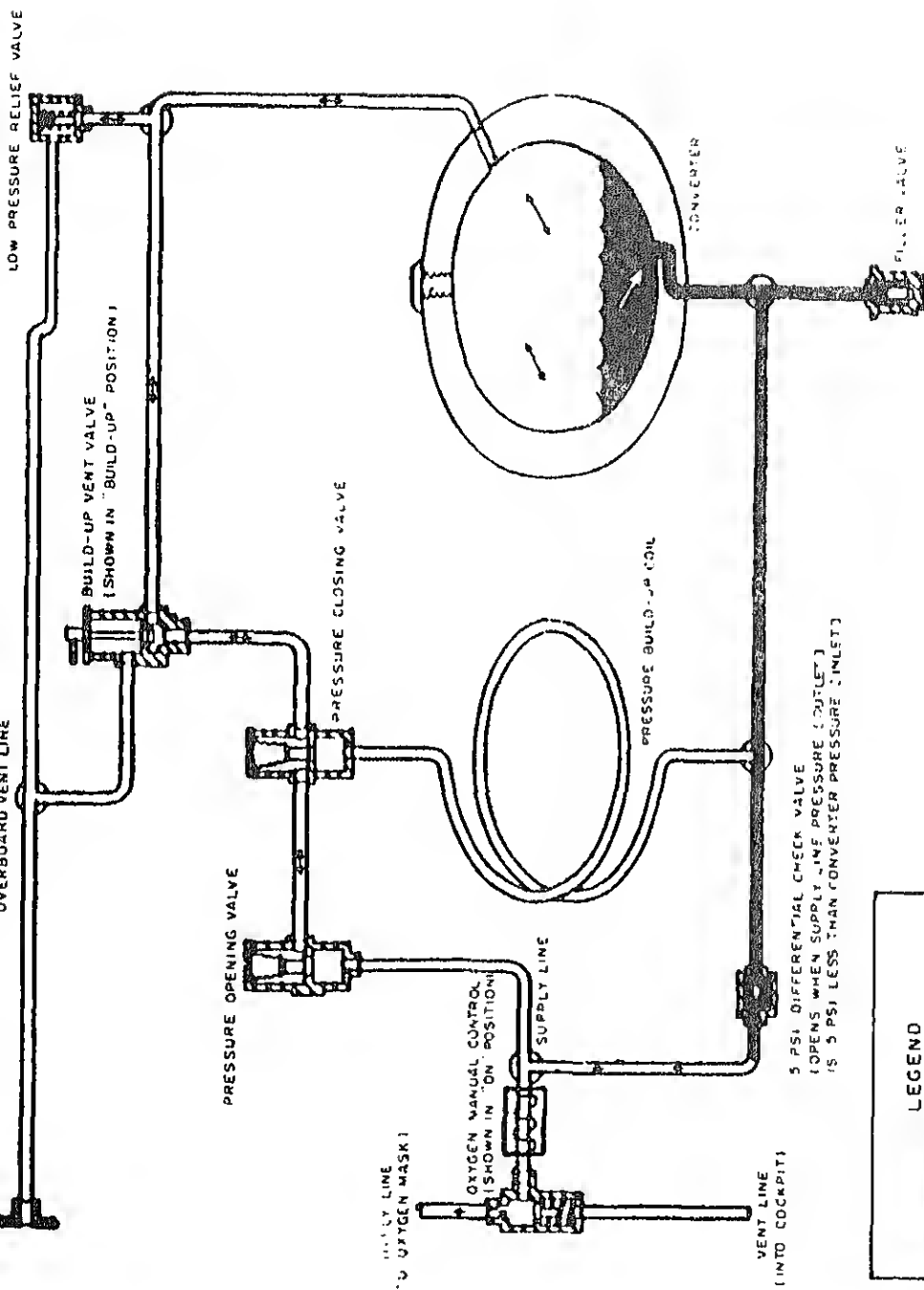
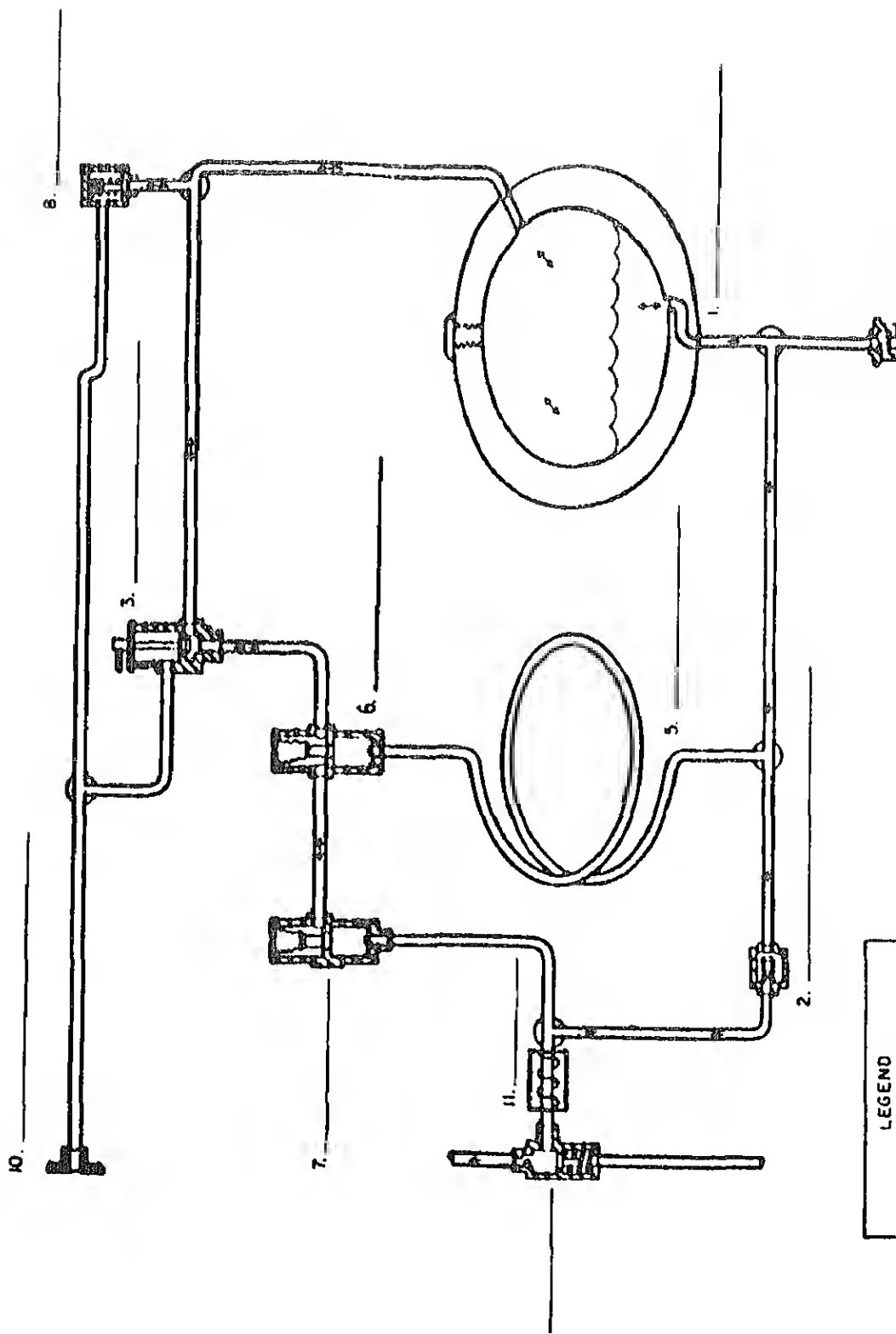


FIGURE 3.2-6--Liquid Oxygen Converter Operation (Demand Mode)



LEGEND

FAMILIARIZATION WITH AIRCRAFT LIQUID OXYGEN SYSTEMS

PRODUCTION

performing your duties as an AME you will be required to maintain, repair, service, and inspect liquid oxygen systems. Due to the inherently dangerous properties of liquid oxygen and high pressures used in some systems, it is extremely important that you understand how these systems operate and the safety precautions that relate to liquid oxygen system maintenance.

TERMINAL OBJECTIVES

supported by this lesson topic.)

ABLING OBJECTIVE

supported partially by this lesson topic.)

supported entirely by this lesson topic.)

2.1.14, 2.1.15, 2.1.16, 2.1.17, and 2.1.18

STUDY ASSIGNMENT

Review Notetaking Sheet 3.2.1N.

Read chapter 10, pages 10-4 through 10-9, and 10-16 through 10-17 in the Aviation Structural Mechanic "E" 3 & 2, NAVEDTRA 10347, 1982 Edition.

Complete Programmed Instruction "A Basic Course on General Handling of Liquid Oxygen" CNTT-N17 PAT.

STUDY QUESTIONS

Select from a given list the advantage(s) of a liquid oxygen system compared to a gaseous system.

- | | |
|---|-------------------------------|
| a. Takes up less space _____ | 1. Liquid oxygen system _____ |
| b. Operates at a greater pressure _____ | 2. Gaseous oxygen _____ |

- e. Takes up greater space _____
- f. Shorter duration _____
- g. Greater in weight _____

Match, from a given list, the three types of liquid oxygen systems with their pressure and flow rate.

- | | |
|------------------------------------|---------------------------------------|
| a. Low pressure, low flow _____ | 3. 65 to 75 p.s.i.
20 liters per m |
| b. Low pressure, medium flow _____ | 4. 350 p.s.i.
120 liters per |
| c. High pressure, high flow _____ | 5. 65 to 75 p.s.i.
70 liters per m |

Match, from a given list, the components of a liquid oxygen system with their purpose and location.

- | | |
|---|---|
| 6. Converter _____ | a. relieves excessive converter pressure overboard - located on converter |
| 7. Liquid oxygen differential check valve _____ | b. opens under pressure controlling maximum operating pressure located on converter |
| 8. Buildup/vent valves _____ | c. opens under pressure controlling normal operating pressure located on converter |
| 9. Filler valve _____ | d. begins initial pressure buildup - located on converter |
| 10. Buildup coil _____ | e. allows small amount of liquid oxygen to enter supply line |
| 11. Pressure closing valve _____ | |
| 12. Pressure opening valve _____ | |
| 13. Low-pressure relief valve _____ | |
| 14. Oxygen "on-off" switch and high pressure relief valve _____ | |

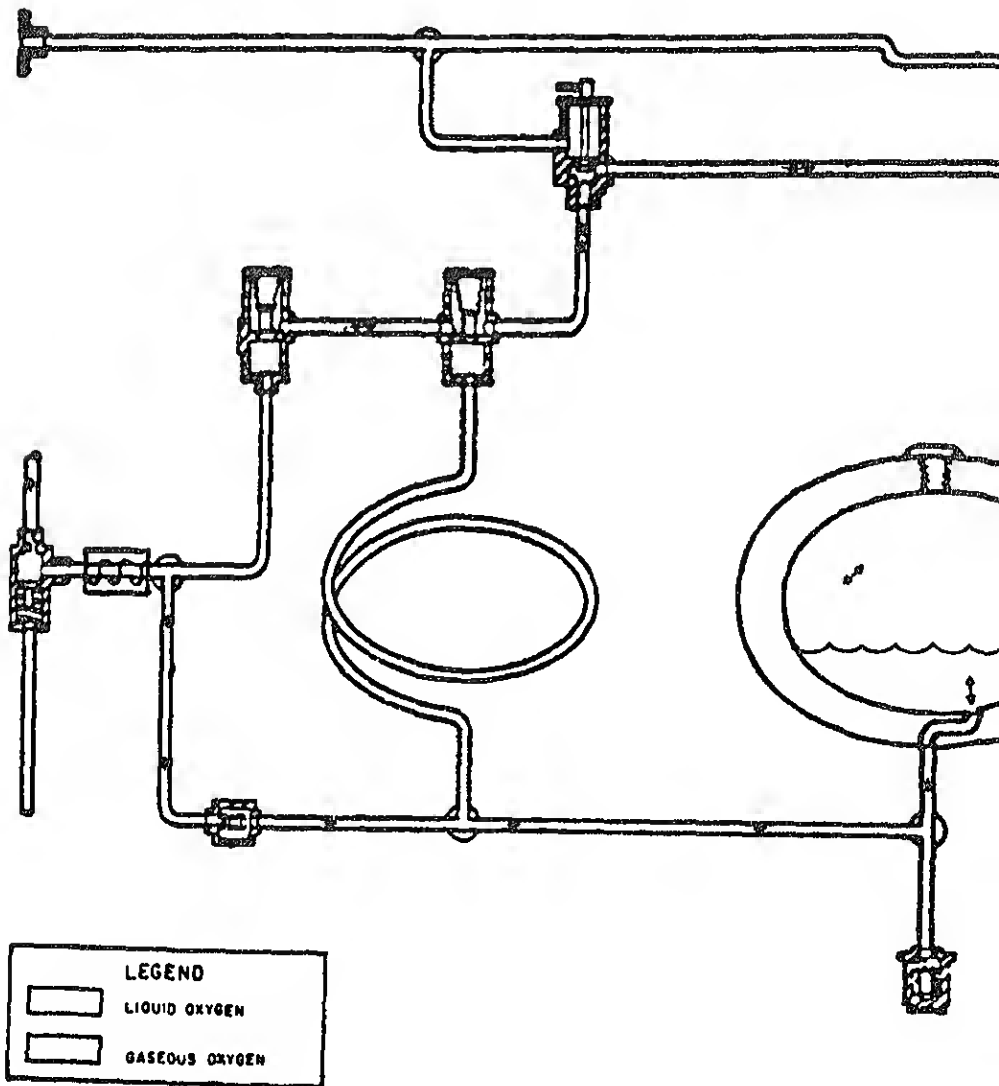
Heat exchanger/warm _____
up plate

- f. used to store and pressurize oxygen in its liquid form - location varies with aircraft
- g. permits liquid oxygen to be vented during filling and confines pressure in system in buildup - located on converter
- h. controls flow of oxygen to regulator and protects aircraft liquid oxygen system - located in cockpit
- i. indicates amount of liquid oxygen system located in cockpit
- j. changes liquid oxygen to gaseous oxygen and warms gases - located in aircraft
- k. allows filling of liquid oxygen converter - located on converter

Select from a list, the safety precautions pertaining to liquid oxygen.

- a. Be thoroughly familiar with your equipment _____
- b. Ensure liquid oxygen is kept free of all hydrocarbons _____
- c. Always wear protective clothing when working with liquid oxygen _____
- d. Do not permit open flames, spark producing tools or smoking in LOX handling areas. _____

18. Using a liquid oxygen flow schematic, trace the normal operation of a liquid oxygen system.



NOTETAKING SHEET 3.3.1N

OPERATION AND MAINTENANCE OF A LIQUID OXYGEN SERVICING TRAILER

REFERENCES:

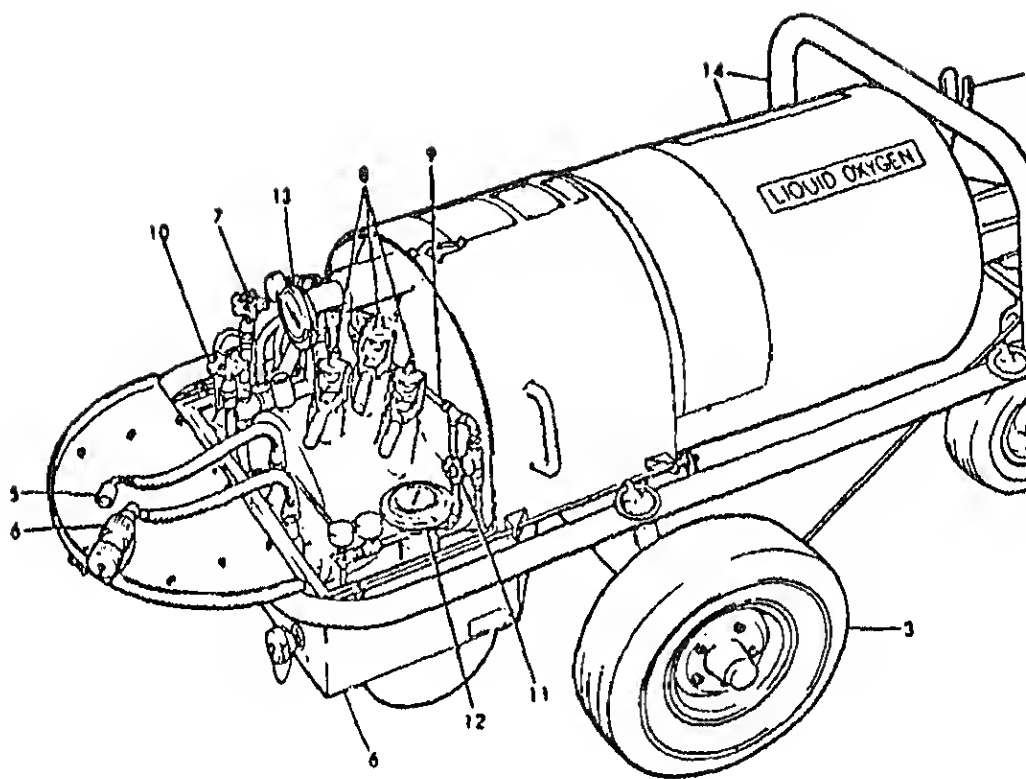
- Storage Tank, Liquid Oxygen Low-loss Closed-loop Type TM
Part No. 22455, NAVAIR 19-25D-26.
- Aviation Clothing and Safety Equipment, BUWEPS Bulletin N
Liquid Oxygen Safety Precautions.
- Protective Clothing for Liquid Oxygen Handlers, NAVAIR I
10332.2, 11 August 1967.
- Aviation Structural Mechanic E 3 & 2, NAVTRA 10309-D, 19
Edition, Chapter 11, Liquid Oxygen System, pages 11-1 th
11-23.

NOTETAKING OUTLINE

Purpose & Description

1. The TMU-70/M is a completely self-contained unit com
of three major components: (see figure 3.3.1)
 - a. _____
 - b. _____
 - c. _____
2. The annular space between the double walls of the st
tank, transfer tank, and internal transfer lines is
to 5 microns or lower.

3. The evacuated space contains a high vacuum insulatio
minimum heat gain and boil-off of the liquid oxygen.
4. The storage and transfer tanks are equipped with liq
and pressure gages and pressure _____
5. The three components are permanently mounted on a th



**INDEX
NO.**

ITEM

- | | |
|----|------------------------------------|
| 1 | Handbrake and Cross Shaft Assembly |
| 2 | Retractable Caster Assembly |
| 3 | Wheel Assembly |
| 4 | Converter Fill Line Assembly |
| 5 | Converter Vent Line Assembly |
| 6 | Cabinet Assembly |
| 7 | Vent Piping Assembly |
| 8 | Toggle Valve Assembly |
| 9 | PBU Coil Assembly |
| 10 | Relief Piping Assembly |
| 11 | Fill Line Assembly |
| 12 | Transfer Tank Indicator Assembly |

U-70/M components.

Storage tank.

a. Purpose

- (1) The purpose of the TMU-70/M is to _____ oxygen vapors caused by heat loss during transfer to the aircraft converters.
- (2) The gaseous oxygen vapors vented from the transfer tank and the converter are returned to the storage tank for _____ and _____.

b. Capacity

The storage tank contains _____ U.S. gallons.

Transfer tank

- a. The transfer tank is a _____ liter capacity, double-walled Dewar and is permanently attached to the storage tank.
- b. The transfer tank is gravity filled from the storage tank.
- c. It is self-contained and operates independently after filling.
- d. The transfer tank is equipped with a pressure build-up coil, relief valve, rupture disc, and controls.

Transfer lines

- a. The transfer lines carry the liquid oxygen from the storage tank to the transfer tank and then to the _____.
- b. They also carry the vented oxygen gas from the converter back to the _____.
- c. The close loop of the transfer lines contains the vented oxygen gas to avoid venting large volumes of gas during converter filling.
- d. The interconnecting liquid and return lines are _____ whenever practical.

Piping system

c. A pressure relief valve system which is connected to the _____ system.

. Controls and indicators. (see figure 3.3-2)

a. Storage tank pressure gage.

(1) Purpose.

(a) The pressure gage indicates the pressure in the inner storage tank.

(b) The gage is calibrated to read from _____.

(2) Operation.

(a) Safe operating pressure of 0 to 55 p.s.i.g. is indicated by _____ on the gage face.

(b) Unsafe pressure of 55 to 100 p.s.i.g. is indicated by a _____.

b. Storage tank liquid level gage.

(1) Purpose.

The liquid level gage directly indicates the level of liquid oxygen in the inner tank, when the tank is sitting level on a level surface.

(2) Operation.

(a) The gage dial is magnetically and mechanically coupled to a _____ inside the storage tank.

(b) _____

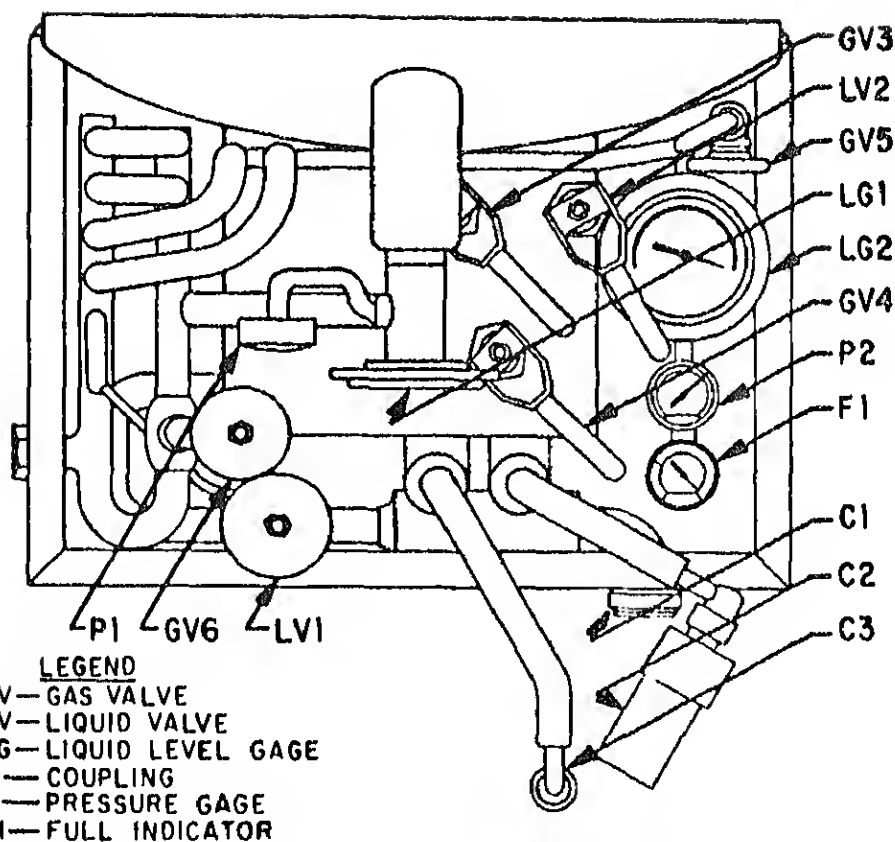
(c) Safe operating level of up to 50 gallons is indicated in green; unsafe operating level of more than 50 gallons is indicated in red.

c. Transfer tank liquid level gage.

(1) Purpose.

The liquid level gage directly indicates the level of liquid oxygen in the transfer tank.

(2) Operation.



STORAGE TANK PRESSURE GAGE (P-1)

STORAGE TANK LIQUID LEVEL GAGE (LG-1)

CONVERTER VENT LINE SHUTOFF VALVE (GV-4)

TRANSFER TANK VENT LINE SHUTOFF VALVE (GV-3)

TRANSFER TANK FILL LINE SHUTOFF VALVE (LV-2)

TRANSFER TANK PRESSURE BUILD UP VALVE (GV-5)

8. TRANSFER TANK PRESSURE GAGE (P-2)

9. CONVERTER FULL INDICATOR GAGE (FI)

10. FILL-DRAIN LINE SHUTOFF VALVE (GV-1)

11. STORAGE TANK VENT LINE SHUTOFF VALVE (GV-6)

12. FILL-DRAIN LINE COUPLING (C-1)

13. AIR FORCE FILLER VALVE (C-3)

(a) The gage is magnetically and mechanically connected to a float sensor inside the transfer tank.

(b) The gage is calibrated in _____.

d. Transfer tank pressure gage.

(1) Purpose.

The _____ indicates the pressure in the transfer tank.

(2) Operation.

(a) The pressure in the transfer tank must be higher than the pressure in the storage tank to allow transfer of liquid since the converter is filled into the storage tank during converter filling.

(b) The gage is calibrated to read from 0 to 160 p.s.i.g.

(c) Safe operating pressure of 0 to 110 p.s.i.g. is indicated by a green band; unsafe pressure above 110 to 160 p.s.i.g. is indicated by a red band.

e. Converter full indicator gage.

(1) Purpose.

The full indicator gage (marked LIQUID GAS) _____ that monitors the vent line temperature.

(2) Operation.

(a) During transfer of liquid to a converter, the gage indicates gas temperature in the vent line.

(b) When the converter is full, the vent line is filled with liquid oxygen overflow, the vent line temperature drops, and the gage indicator moves to the _____ position that indicates a full converter.

f. Converter vent line shut-off valve.

The vent valve controls the flow of oxygen gas from the converter being filled to the storage tank and prevents the loss of storage tank gas when a converter is

Transfer tank vent line shut-off valve.

The vent valve controls the flow of _____ from the transfer tank to the vapor space of the storage tank.

Transfer tank fill line shut-off valve.

The valve is used to control the _____ of liquid oxygen from the storage tank to the transfer tank.

Transfer tank pressure build-up valve.

- (1) The pressure valve controls the flow of liquid oxygen from the bottom of the transfer tank to the _____ (PBU).
- (2) The PBU coil is a _____ where the liquid oxygen is exposed to ambient temperature and is converted to gas.
- (3) As the liquid is changed to gas it expands. The out gas of the PBU coil is fed back to the transfer tank vapor space, providing pressure to discharge liquid the converter.
- (4) This valve is _____ when pressure is required fill the converter.

Fill/drain line shut-off valve.

- (1) The fill valve is used during the storage tank filling operation to permit the flow of liquid oxygen from a central supply tank to the storage tank.
- (2) The shut-off valve is opened _____ during the filling function and then closed after the transfer has been completed.

CAUTION: The fill/drain line shut-off valve is not used to control flow. Restricting transfer flow may create a dangerous back pressure in the supply line used for filling. Control transfer flow shall be maintained with the service valve of the central supply tank.

Storage tank vent line shut-off valve.

- (1) The vent is used to control the release of gaseous vapors from the storage tank to the vent piping manifold.

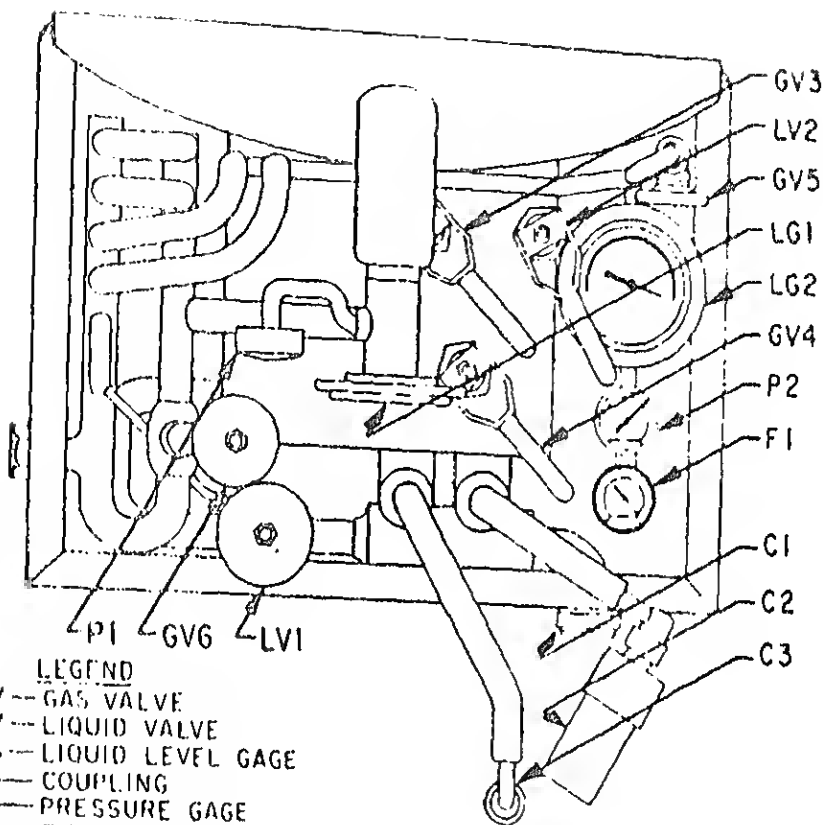
- (3) During _____ the valve is left
OPEN position to vent all vapors generated by
liquid oxygen boil-off.
- (4) In _____ the valve is left closed
to prevent oxygen vapor contact with flammable liquids
or vapors.

1. Relief valves.

- (1) The relief valves are installed to relieve excess
pressure in the storage and transfer tanks.
- (2) The relief valves are set to operate at a
predetermined pressure.
- (3) In case of a malfunctioning relief valve, _____
are installed as a back-up safety precaution.
- (4) The evacuated annular space of the storage tank is
protected against pressure buildup by an _____
_____.

2. Safety precautions.

1. Never allow liquid oxygen to contact the skin. The low
temperature of the liquid quickly freezes the area and
severe frostbite results. If the skin is splashed with
liquid, immediately flush the area thoroughly with water
then obtain first aid.
2. Always store liquid oxygen with the vent valve open.
Relief valves furnished on the tank are provided to protect
the case in case of malfunction and are not to be used as
pressure regulators.
3. Never confine liquid oxygen in any piping or container
without adequate safety devices. The pressure built up when
the liquid expands to gas will rupture most piping, tanks,
or containers.
4. Comply with all safety directives. Fifty feet has been
established as the safe distance criterion for oxygen
equipment. Assure painting and marking on the tank are
maintained as required. Oxygen gas does not burn but
supports combustion of any material which does burn.
5. Keep liquid oxygen away from absorbent materials, loose
clothing, or rags. These materials can trap oxygen and
later be ignited by a spark, cigarette, or a match.



LEGEND
 GV --- GAS VALVE
 LV --- LIQUID VALVE
 LG --- LIQUID LEVEL GAGE
 C --- COUPLING
 P --- PRESSURE GAGE
 FI --- FULL INDICATOR

CLOSE ALL VALVES BEFORE STARTING ANY OPERATIONS

FILL MAIN TANK

1. CONNECT C1 TO SUPPLY TANK
2. OPEN GV6 & LVI & OBSERVE LG1
3. WHEN TANK IS FULL CLOSE LVI & DISCONNECT C1

FILL TRANSFER TANK

1. OPEN LV2 & GV3 & OBSERVE LG2
2. WHEN TANK IS FULL CLOSE LV2 & GV3

FILL CONVERTER

1. FILL TRANSFER TANK
2. OPEN GV5 & OBSERVE P2 PRESSURIZE 80-100 PSIG
3. CONNECT C3 & C2 TO CONVERTER
4. OPEN GV4 & OBSERVE FI
5. WHEN FI INDICATES LIQUID DISCONNECT C2
6. CLOSE GV4 & DISCONNECT C3

Filling procedure. (see figure 3.3-3)

1. Ensure that all required safety equipment is in use and all safety precautions are taken.

CAUTION: The vacuum in the annular space must be 5 mic or less before filling operation commences.

2. Close all control valves
3. Place the TMU-70/M on a level surface to ensure that the has a level attitude.
4. Pressurize the liquid oxygen supply tank to the required pressure for transfer of liquid oxygen to the TMU-70/M.
5. Remove dust cover from free end of the supply tank transfer hose and purge hose.
6. Remove the dust cover from fill/drain line coupling (C- connect the transfer hose.
7. Open storage tank (GV-6) and fill/drain line shut-off valve (LV-1).

CAUTION: Pressure should not be allowed to rise above _____ in storage tank. Monitor storage tank pressure gage (P-1) closely during cool-down.

8. Slowly open the service valve on the supply tank to allow only a _____ flow of liquid oxygen through the transfer hose into the TMU-70/M. Considerable vaporization will take place until the transfer hose, fill/drain line, and storage tank have cooled down.
9. When the transfer hose, fill hose, and storage tank have cooled down sufficiently to handle a full flow of liquid oxygen, open the service valve on the supply tank completely.

NOTE: Observe the time required to fill the storage tank. Filling time varies with each supply line system. However, with a transfer pressure of 30 p.s.i.g., and under normal conditions, the storage tank should be filled within a period of minutes. Each using activity should determine an average time with the equipment at hand. Abnormal deviation from the average filling time should be cause for investigation.

10. Monitor storage tank liquid level gage LG-1.

11. Close fill/drain line shut-off valve (LV-1).

CAUTION: Use extreme caution when disconnecting the hose. Even though the hose has been drained and pressure relieved, some liquid oxygen will remain. Do not direct the hose toward personnel or equipment.

12. Disconnect the supply tank transfer hose, immediately cap both ends of liquid oxygen product and pressure, and replace coupling caps loosely. Tighten the coupling caps and ensure that all liquid oxygen has vaporized and bled off.
13. Close all control valves except _____

E. Preparation for servicing. (see figure 3.3-3)

1. Ensure that all safety equipment is in use.
2. _____
 - a. Fill/drain line shut-off valve.
 - b. Transfer tank fill line shut-off valve.
 - c. Transfer tank vent line shut-off valve.
 - d. Converter vent line shut-off valve.
 - e. Transfer tank pressure build-up valve.
 - f. Storage tank vent line shut-off valve.
3. Observe storage tank liquid level gage and the pressure to ensure _____ liquid oxygen supply and safe _____.
4. Open the transfer tank fill valve and the transfer tank vent line shut-off valve.
5. Observe the transfer tank liquid level gage. When the tank is full, close the transfer tank fill line shut-off valve and the transfer tank vent line shut-off valve.
6. Connect the converter vent line connectors to the _____.
7. Connect the air-force-filler valve to the converter tank fitting, using a _____.

8. Open the transfer tank pressure build-up valve momentarily and observe the transfer tank pressure gage. When pressure rises to approximately close the transfer pressure build-up valve.

WARNING: The rate of pressure buildup depends on the liquid level in the tank. On a full tank the pressure build extremely fast because of the small amount of vapor space to be filled. Use extreme caution when building the pressure and never allow the pressure to exceed 90 p.s.i.g. Open the transfer tank vent valve to relieve the excess pressure into the storage tank if the pressure buildup indicates that it will exceed 90 p.s.i.g. This will avoid the unnecessary opening of the transfer inner tank shell relief valve and resultant undesirable discharge of gaseous oxygen from the vent line.

9. Operate the transfer tank pressure build-up valve _____ to maintain the desired pressure during converter servicing function.
10. Open the converter vent line shut-off valve and observe the converter full indicator gage. The gage should indicate LIQUID as the converter is filling and LIQUID when the converter is full.
11. When the converter full indicator gage indicates LIQUID, disconnect the _____.
12. Close the _____.
13. Close the converter vent line shut-off valve and disconnect the converter vent line connector.

NOTE: If additional converters are to be serviced immediately, omit steps 14 and 15.

14. To empty the transfer tank.
 - a. Open the transfer tank fill line shut-off valve.
 - b. Then the transfer tank pressure build-up valve (if necessary).
 - c. Observe the transfer tank liquid level gage.
 - d. When the transfer tank is empty, close the transfer tank fill line shut-off valve.

paration for use when received from supply.

The TMU-70/M, when received from the factory or when it is returned from the overhaul activities, is ready to be filled with liquid oxygen and pressurized for _____.

The annular space has been evacuated to the point desirable for a warm and empty tank.

NOTE: For any other preparation or maintenance, the appropriate manual, etc., will be consulted.

JOB SHEET 3.3.1J

SERVICING AN AIRCRAFT LIQUID OXYGEN CONVERTER USING THE TMU-70/M LIQUID OXYGEN SERVICING TRAILER

PRODUCTION:

C's in the fleet today must know and understand the operation and maintenance of the equipment used in handling liquid oxygen.

PRINCIPAL OBJECTIVE:

Supported partially by this lesson topic:

1.

ENABLING OBJECTIVES:

Supported partially by this lesson topic:

2.

Supported entirely by this lesson topic:

2.1.19 through 2.1.23.

REFERENCES:

Storage Tank, Liquid Oxygen Low-Loss, Closed-Loop, Type 1, Part No. 22455, NAVAIR 19-25D-26.

Aviation Clothing and Safety Equipment, BUWEPS Bulletin 10332.2 11 August 1967.

Protective Clothing for Liquid Oxygen Handlers, NAVAIRIN 10332.2 11 August 1967.

Aviation Structural Mechanic E, 3 & 2, NAVEDTRA 10309-D, Edition, Chapter 11, Page 11-1 through 11-16.

EQUIPMENT AND MATERIALS:

Aircraft converter.

Protective Clothing:

a. Face shield.

3. Trailer, TMU-70/M Liquid Oxygen.

PRECAUTIONS TO BE OBSERVED:

1. Ensure fire extinguisher is present when servicing.
2. Check area for hydrocarbons.
3. Ensure all protective clothing is being used.

JOB STEPS:

1. Prepare trailer for servicing:

a. Close all control valves:

- (1) Fill drain line shut-off valve.
- (2) Transfer tank fill line shut-off valve.
- (3) Transfer tank vent line shut-off valve.
- (4) Converter vent line shut-off valve.
- (5) Transfer tank pressure build-up valve.
- (6) Storage tank vent line shut-off valve.

b. Check storage tank liquid level gage, and state the level _____. Check pressure gage for safe operating pressure.

c. Fill transfer tank

- (1) Open the transfer tank fill valve and the transfer tank vent line shut-off valve.
- (2) Monitor transfer tank liquid level gage until full.
 - (a) Close the transfer tank fill line shut-off valve.
 - (b) Close the transfer tank vent line shut-off valve.

2. Filling converter

- a. Connect the converter vent line connector to the converter vent fitting.
- b. Remove dust cap from converter filler valve.

- (1) First, position the valve against the purge fitting, turn the housing clockwise, locking the valve in the closed position.
- (2) Second, push the knurled knob forward and rotate clockwise, locking the valve in the open position.

d. Open transfer tank pressure build-up valve.

WARNING: Observe transfer tank pressure gage, do not allow pressure build-up in excess of 90 p.s.i.g.

e. Close transfer tank pressure build-up valve when pressure reading is 90 p.s.i.g.

f. Operate transfer tank pressure build-up valve as necessary to maintain the desired pressure during converter service.

g. Open the converter vent line shut-off valve and observe converter full indicator gage.

(1) Gage should read GAS when converter is filling.

(2) When full, gage will indicate LIQUID.

h. When the converter is full, disconnect the AF filler line.

i. Install dust cap to converter filler valve.

Securing trailer

a. Close the transfer tank pressure build-up valve.

b. Close the converter vent line shut-off valve.

c. Disconnect converter vent line connector.

d. Empty the transfer tank.

(1) Open transfer tank fill line shut-off valve.

(2) Open transfer tank pressure build-up valve.

(3) Observe transfer tank liquid level gage.

(4) When the transfer tank is empty, close the transfer tank pressure build-up valve and the transfer tank fill line shut-off valve.

e. Close all valves, except the storage tank vent line shut-off valve, for normal idle storage.

ASSIGNMENT SHEET 3.3.1A

OPERATION AND MAINTENANCE OF A LIQUID OXYGEN SERVICING TRAILER

INTRODUCTION

Modern Naval Aviation the uses of these liquids are becoming more prominent. AME's in the fleet today must know and understand the operation and the maintenance of the equipment used in handling the liquids. Because of the extreme low temperature of these liquids, all safety precautions must be known and strictly observed to prevent serious accidents.

LEARNING OBJECTIVE:

(Supported partially by this lesson topic.)

).

LEARNING OBJECTIVES:

(Supported partially by this lesson topic.)

.

(Supported entirely by this lesson topic.)

.19 through 2.1.23.

READING ASSIGNMENT:

Review Notetaking Sheet 3.3.1N.

Read Page 11-1 to 11-16 in Aviation Structural Mechanic E, 3rd Edition, NAVEDTRA 10309-D.

DISCUSSION QUESTIONS: Using the Notetaking Sheet and Reading Assignment, answer the following questions.

What is the purpose of the TMU-70/M Liquid Oxygen Storage Tank?

What are the safe operating pressures of the TMU-70/M?

What are procedures for securing the TMU-70/M?

Which valves are opened to empty the transfer tank?

What are six safety precautions to be observed when working with liquid oxygen?

MAINTENANCE OF AN AIRCRAFT LIQUID OXYGEN SYSTEM

REFERENCES:

Aviation Structural Mechanic E, 3&2, NAVEDTRA 10309-D.

The Naval Aviation Maintenance Program (NAMP), OPNAVINST (series).

Handbook of Maintenance Instructions, Navy Models A4A and Aircraft, NAVAIR 01-40 AVA-2-4, Section IV, Utility System

Periodic Maintenance Requirements Manual, Navy Models TA-A4B, and A-4C Aircraft, NAVAIR 01-40AVA-6, Section II, Part Aircraft Periodic Maintenance Requirements.

ETAKING OUTLINE

Description.

1. The liquid oxygen supply is stored in an insulated container mounted in the _____.
2. The converter is reached through the after fuselage compartment _____.
3. The converter contains _____ of liquid oxygen serviced to capacity.
4. It is a low-pressure, _____ system, and consists essentially of the following components.
 - a. _____.
 - b. Low-pressure relief valve.
 - c. Buildup/vent valve.
 - d. Pressure closing valve.
 - e. Pressure opening valve.
 - f. Differential check valve.
 - g. Oxygen manual control and high-pressure relief valve.

1. Interval.

- a. Even if the aircraft is not to be flown immediately, converter should be filled to preclude possible _____ of the system.
- b. Loss of liquid oxygen because of evaporation, based on a standard day at sea level, is approximately _____ with system idle for a 24 hour period.
- c. Therefore, the longer a converter stands idle without refilling, the less oxygen is available to the pilot for breathing.
- d. Converter should be completely refilled just _____.

2. Filling procedure.

- a. Visual inspection.
 - (1) all electrical power "off".
 - (2) _____.
 - (3) CO₂ extinguisher present.
 - (4) Check area and aircraft for oil and grease (particularly the left wing).

b. Prepare aircraft.

- (1) Make certain oxygen switch in cockpit is in "on" position.
- (2) Open after compartment access door.

NOTE: Placing tools on top of the wing could inadvertently remove the protective coating and corrosion would set in.

- (3) _____.

3. Lox converter removal.

- a. Ensure aircraft electrical power is "OFF".
- b. Disconnect aircraft quantity indicating probe lead from converter.

from converter.

- d. Disconnect aircraft vent line quick disconnect from converter.
 - e. Loosen wing nut enough to clear converter support bracket.
 - f. Slide converter out and remove from aircraft.
-
-
-

Install lox converter.

- a. Install converter in aircraft lox compartment.
- b. Raise wing nut to converter support bracket and tighten wing nut.
- c. Connect aircraft vent line quick disconnect to converter connection.
- d. Connect aircraft supply line quick disconnect to converter connection.
- e. Connect quantity indicating probe leads to converter.
Have instructor inspect installation.
- f. Secure converter access panel.

Additional Check of a Lox System.

Connect oxygen mask to _____.

Place oxygen switch in "on" position.

Test oxygen mask regulator by breathing deeply several times.

Remove mask and place oxygen switch to "off" position.

Connect electrical power to aircraft and read quantity registered on _____.

Disconnect electrical power from aircraft.

1. Wear protective clothing while servicing liquid oxygen.
2. Ensure area and equipment are free of hydrocarbons.
3. Ensure electrical power (external) is "off" before removing or installing ground power plug.
4. Ensure fire extinguisher is in the immediate area.
5. Ensure aircraft and servicing trailer are properly gro

JOB SHEET 3.4.1J

(DEMONSTRATION)

MAINTENANCE OF A LIQUID OXYGEN SYSTEM

INTRODUCTION

In this job sheet you will perform a functional check of a liquid oxygen system. You will use knowledge and skill that you have previously mastered to help you complete this job sheet.

LEARNING OBJECTIVE

Supported partially by this lesson topic:

1.0.

ENABLING OBJECTIVES

Supported partially by this lesson topic:

1.1.

Supported entirely by this lesson topic:

1.1.24 thru 1.1.27.

REFERENCES:

- 1. Aviation Structural Mechanic E, 3&2, NAVEDTRA 10309-D 1981 Edition, Chapter 10.
- 2. The Naval Aviation Maintenance Program, (NAMP), OPNAVINST 4790.2 (series).
- 3. Handbook of Maintenance Instruction, Navy Models, A-4A and A-4B Aircraft, NAVAIR 01-40AVA-24, Section IV, Utility Systems.
- 4. Periodic Maintenance Requirements Manual, Navy Models TA-4A, A-4B, and A-4C Aircraft, NAVAIR 01-40AVA-6, Section II, Periodic Maintenance Requirements.

EQUIPMENT AND MATERIALS

Converter, Liquid Oxygen (partially full).

Mask, Oxygen A-13A with mini-regulator.

1. Wear protective clothing while servicing liquid oxygen.
2. Ensure area and equipment are free of hydrocarbons.
3. Ensure electrical power (external) is "off" before removing or installing ground power plug.
4. Ensure fire extinguisher is in the immediate area.
5. Ensure aircraft and servicing trailer are properly grounded.

- a. Install converter in aircraft LOX compartment.
- b. Raise wing nut to converter support bracket and tighten wing nut.
- c. Connect aircraft vent line quick disconnect to converter connection.
- d. Connect aircraft supply line quick disconnect to converter connection.
- e. Connect quantity indicating probe leads to converter.
Have instructor inspect installation.
- f. Secure converter access panel.
- g. Inform instructor that you are going to enter the cockpit.
- h. Ensure all switches are in the off, safe, or normal position.
- i. Inform instructor that you are ready to perform the functional test.
- j. Functional test

Procedure	Required Result
1. Place oxygen mask on face. Do not connect oxygen mask hose to aircraft liquid oxygen system. Exhale.	No noticeable resistance to exhalation
2. Inhale.	Inhalation should be difficult indicating exhalation valve seating properly.

- | | |
|--|--|
| 3. With oxygen mask in place, connect oxygen mask hose to aircraft liquid oxygen system. | <p style="text-align: center;">WARNING</p> <p>Connections of the oxygen supply tubes must be checked for tightness before moving the oxygen switch to ON. Escaped oxygen creates a fire hazard if the presence of oil or grease. Failure to comply may result in injury to personnel.</p> |
|--|--|

. Place oxygen control switch on.

. Breathe deeply several times.

No noticeable resistance
breathing.

CAUTION

NOTE

Free flow test through
oxygen mask must not
exceed 1 minute.

If excessive breath
resistance is encou
inspect all quick-
disconnects for pro
seating.

. Remove oxygen mask from face.

. Place oxygen control switch off.

Flow of oxygen stops

. Disconnect oxygen mask hose.

. Remove converter

a. Ensure aircraft electrical power is "OFF".

b. Disconnect aircraft quantity indicating probe leads
converter.

c. Disconnect aircraft supply line quick disconnect from
converter.

d. Disconnect aircraft vent line quick disconnect from
converter.

e. Loosen wing nut enough to clear converter support br

f. Slide converter out and remove from aircraft.

ASSIGNMENT SHEET 3.4.1A

MAINTENANCE OF AN AIRCRAFT LIQUID OXYGEN SYSTEM

INTRODUCTION

Purpose of this assignment sheet is to familiarize you with the maintenance of an aircraft liquid oxygen system.

GENERAL OBJECTIVE

Identified partially by this lesson topic:

LEARNING OBJECTIVES

Identified partially by this lesson topic:

Identified entirely by this lesson topic:

2.1.4 thru 2.1.27.

ASSIGNMENT

Review notetaking sheet 3.4.1N.

Read Chapter 10, Pages 10-5 thru 10-20, in the Aviation Structural Mechanic E; 3&2, NAVEDTRA 10309-D.

QUESTIONS

What are the nine components which make up a liquid oxygen system?

What procedures are required for removing the lox converter?

What procedures are required for installing the lox converter?

What are the five safety precautions to be observed while working on a liquid oxygen system?

What are the principal differences between the liquid oxygen system?

me start _____
 me stop _____
 tal time _____

PROCEDURE:

POINT

Ensure that all safety precautions are observed

- a. Protective clothing 4
- b. Inspect trailer and surrounding area for hydrocarbons. 4
- c. Ensure that a fire extinguisher is available. 4

Prepare trailer for servicing

- a. Close all control valves
 - (1) Fill/drain line shut-off valve. 2
 - (2) Transfer tank fill line shut-off valve. 2
 - (3) Transfer tank vent line shut-off valve. 2
 - (4) Converter vent line shut-off valve. 2
 - (5) Transfer tank pressure build-up valve 2
 - (6) Storage tank vent line shut-off valve 2

- b. Check storage tank liquid level gage, and state the amount of lox _____, and check pressure gage for safe operating pressure. 4

c. Fill transfer tank

- (1) Open transfer tank fill line shut-off valve and the transfer tank vent line shut-off valve . . . 4
- (2) Monitor transfer tank liquid level gage until tank is full.
 - (a) Close the transfer tank fill line shut-off valve 2
 - (b) Close the transfer tank vent line shut-off valve 2

Filling the converter

- a. Connect the converter vent line connector to the converter filling (C-3) 2
- b. Connect the AF filler valve to the converter, using the two step procedure
 - (1) First, position the valve against the purge fitting and turn the housing clockwise, locking the valve in place 2

- (2) Second, push the knurled knob forward and rotate clockwise, locking the valve in the open position.
- c. Open transfer tank pressure build-up valve (GV-5).

WARNING: Observe transfer tank pressure gage, do not allow pressure build-up in excess of 90 p.s.i.g.

- d. Close transfer tank pressure build-up valve when pressure reading is 90 p.s.i.g.
- e. Operate transfer tank pressure build-up valve as necessary to maintain the desired pressure during converter servicing
- f. Open the converter vent line shut-off valve and observe the converter full indicator gage.
 (1) Gage should read GAS when converter is filling
 (2) When full, gage will indicate LIQUID
- g. When the converter is full, disconnect the AF filler valve
- h. Install dust cap to converter filler valve

Securing trailer

- a. Close the transfer tank pressure build-up valve.
- b. Close the converter vent line shut-off valve
- c. Disconnect converter vent line connector
- d. Empty the transfer tank.
 (1) Open transfer tank fill line shut-off valve.
 (2) Open transfer tank pressure build-up valve
 (3) Observe transfer tank liquid level gage
 (4) When the transfer tank is empty, close the transfer tank pressure build-up valve and the transfer tank fill line shut-off valve
- e. Close all valves except for storage tank vent line shut-off valve, for normal idle storage

Documentation

- a. Complete Support Action Form (SAF), using the following information:

To support the operation of an A-4A aircraft, type equipment code (AACA), assigned to organizational squadron GC7, work center 13B serviced the LOX system on today's date in general support of aircraft bureau number 152513.

- Support action form will be graded as follows:

Each block correctly documented will have a two point value.

equipment.
 your work assignment in the mainten

ENABLING OBJECTIVE

Supported partially by this lesson topic:
1.7 and 2.4.

REFERENCES:

1. Naval Aviation Maintenance Program (NA 4790.2 (Latest rev.)).
2. Safety Precautions for Shore Activities

EQUIPMENT AND MATERIALS:

1. Tools
2. Cleaning gear

PRECAUTIONS TO BE OBSERVED:

Take all necessary steps to ensure your safe equipment.

JOB STEPS:

1. Classroom Support Equipment
 - a. Repair or replace any defective classroom equipment.
 - b. Stow instructional training aids in instructor.
- Shop Support Equipment
 - a. Repair or replace any defective shop
 - b. Service TMU/70M LOX Servicing trailer
 - c. Stow shop support equipment in areas instructor.

PERFORMANCE TEST 3.3

- (2) Second, push the knurled knob forward and rotate clockwise, locking the valve in the open position.

- c. Open transfer tank pressure build-up valve (GV-5).

WARNING: Observe transfer tank pressure gage, do not allow pressure build-up in excess of 90 p.s.i.g.

- d. Close transfer tank pressure build-up valve when pressure reading is 90 p.s.i.g.
- e. Operate transfer tank pressure build-up valve as necessary to maintain the desired pressure during converter servicing
- f. Open the converter vent line shut-off valve and observe the converter full indicator gage.
(1) Gage should read GAS when converter is filling .
(2) When full, gage will indicate LIQUID
- g. When the converter is full, disconnect the AF filler valve
- h. Install dust cap to converter filler valve

4. Securing trailer

- a. Close the transfer tank pressure build-up valve.
- b. Close the converter vent line shut-off valve
- c. Disconnect converter vent line connector
- d. Empty the transfer tank.
(1) Open transfer tank fill line shut-off valve.
(2) Open transfer tank pressure build-up valve
(3) Observe transfer tank liquid level gage
(4) When the transfer tank is empty, close the transfer tank pressure build-up valve and the transfer tank fill line shut-off valve
- e. Close all valves except for storage tank vent line shut-off valve, for normal idle storage

5. Documentation

- a. Complete Support Action Form (SAF), using the following information:

To support the operation of an A-4A aircraft, type code (AACA), assigned to organizational squadron GC7 center 13B serviced the LOX system on today's date in support of aircraft bureau number 152513.

- b. Support action form will be graded as follows:

MAINTENANCE OF SHOP SUPPORT EQUIPMENT

TIME: 2 pe

INTRODUCTION:

The purpose of this sheet is to guide you step-by-step in a practical work assignment in the maintenance of shop support equipment.

ENABLING OBJECTIVE

Supported partially by this lesson topic:

1.7 and 2.4.

REFERENCES:

1. Naval Aviation Maintenance Program (NAMP), Volume II, OPN 4790.2 (Latest rev.).
2. Safety Precautions for Shore Activities, NAVMAT P-5100.

EQUIPMENT AND MATERIALS:

1. Tools
2. Cleaning gear

PRECAUTIONS TO BE OBSERVED:

Take all necessary steps to ensure your safety and that of the equipment.

JOB STEPS:

1. Classroom Support Equipment
 - a. Repair or replace any defective classroom support equipment.
 - b. Stow instructional training aids in areas designated instructor.
2. Shop Support Equipment
 - a. Repair or replace any defective shop support equipment.
 - b. Service TMU/70M LOX Servicing trailer.

Field-day Classroom. Field-day classroom in accordance with
course instructions.

Date _____
Instructors initials _____

UNIT 3 GRADE SHEET

<u>MENT SHEETS</u>	<u>NO.</u>	<u>SAT.</u>	<u>UNSAT.</u>	<u>REMARKS</u>
	13			
	18			
	6			
	5			

WORK

(Demonstration)

Raw Score _____

Converted Score _____

ANCE TEST

Raw Score _____

X .20

Converted score _____

ORE _____ / _____

converted

AVERAGE _____AVERAGE _____CONVERSION TABLE

90 - 99 = 9.7 Outstanding

80 - 89 = 8.5 Excellent

70 - 79 = 7.5 Good

63 - 69 = 6.3 Satisfactor

* 3.0 Unsatisfac

* To be assigned
course superviREMARKS